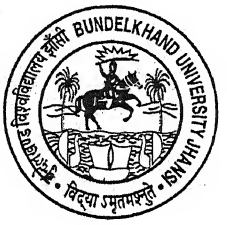
"Screening of Plant Material for Antifeedant and Antifungal Activity during Storage of Cereals"

Thesis

Submitted for Award of

Doctor of Philosophy

in Botany



Bundelkhand University

Jhansi (U.P.)

2002

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Certificate

I hereby certify that this thesis entitled ***"Screening of plant material for antifeedant and antifungal activity during storage of cereals"*** is an original piece of research work carried out **Anamika Mishra** under my guidance & supervision and also carried lab work for more than 200 days for the Degree of Doctor of Philosophy of Bundelkhand University, Jhansi (U.P.). She fulfills all the requirement laid under the clause Ph.D. Ordinance Bundelkhand University, Jhansi.

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ACKNOWLEDGEMENT

I am highly indebted to my supervisor (Guru) ***Dr. M.C. Kanchan****Esq my most respectful Guide and Supervisor for suggesting me the present problem and his esteemed and constant guidance throughout the course of present study. His guidance and advise in each step was very helpful and encouraged me with his soothing words and explainations at every step.*

I feel obliged and am thankful to ***Dr. U.P. Singh,*** *Principal, Bipin Bihari P.G. College, for his valuable suggestions and providing all the laboratory facilities.*

I express my sincere thanks to ***Dr. B.K. Bhadoria*** *(Biochemistry Department) IGFRI Jhansi (U.P.) for his interest and providing all necessary laboratory facilities for UV specctrum analysis of my research samples and* ***Dr. Alok Krishnan*** *(Scientist Aromatic oil research institute of Lucknow) for sparing some time from their's valuable schedule and ~~allowingand~~ allowing me to consult the library for appropriate literature.*

My sincere thanks to ***Dr. A.K. Shrivastava,*** *Prof. Of Zoology department B.B.C. College Jhansi (U.P.) for his kind blessings and encouragement given to me from time to time.*

I am thankful to ***Dr. Faruchki,*** *Senior Scientist of Grassland for his critical suggestions and help in laboratory bioassays of the test insects.*

Parents also contributed to the completion of work though indirectly. I am thankful to my Parents ***Shri J.N. Mishra and Smt. Shoba Mishra****. I am also thankful to my elder brothers* ***Ashish Mishra and Atul Mishra*** *who at every step on boosting me. I am also thankful to my* ***Bhabhi,*** *younger sister* ***Aparajita***

Mishra and my respected Mousi, Mousaji ***Mr. Shubhash Shukla and Mrs. Renu Shukla*** *respectively.*

I am grateful to all teacheres of department, friends and fellow senor research scholars who also helped me during the of my work.

Thanks to the Almighty who is the key source of Enlightenment.

(ANAMIKA MISHRA)

CONTENTS

SECTION 1

INTRODUCTION

INTRODUCTION

Use of repellents and antifeedants obtained from indegenous plants is still in experimental stage in India and very little work has been done on its effectiveness in food material against insect pest which could kill the insect.

In a country like India where population touches 100,000,000 there is an urgent need to protect food grains during storage since they are particularly infested by insects. There is enormous consumption of pesticides and insecticides which cause enormous environmental pollution and health hazards. Therefor search for alternative protectants of plants origin which are comparatively less harmfull to mammals and higher animals, needs to be conducted.

Although the use of plant species to control insect pests has been in practice for centuries, but to a limited extent, it has been only recently that interest has renewed in the pest management potential of natural products. More than 20,000 species of field and storage pests annually destroy approximately one third of the world's food production, valued at more than $100 billion among which highest losses (43% of potential production) occur in developing Asian countries (Ahmed and Grainge, 1986). Post harvest loss has been estimated up to 50% in developing country (Sinha, 1993).

Because of increased population urbanization and industrialisation there is not only an immediate need of growing high yielding

crops but also to develop effective means of storage so that whatever yield is obtained is not destroyed, particullarly by insects during storage.

For insect control a number of pesticides are available in the market amounting to about 58,000 tons during 1983-84. These cause an environment full of polluted dust. Thus there is an urgent need to create resources for alternative methods for protection of crops against insects.

The extracts and essential oils of some medicinal plants have been examined. Chemical investigations of a number of plants have also been done but from different angles.

More than 20,000 species of field and storage pests are annually destroyed. In India Callosobruchus chinensis, Callosobruchus maculaes and Callosobruchus analis are common pests which damage seeds of leguminous plants, where they breed successfully in harvested seeds and pass many generation till the seed are destroyed.

In the present study attempt have been made to control leguminous seeds of Urd, Mung, White gram, Black gram and Lentil against insect pest Callosobruchus chinensis. Hairy catter pillar Diacrisia obliqua is versatile, wildly distributed, polyphagous insect pests causing heavy damage to Jowar, Ground-nut, Jute and many Vegetable. These insects may eat-up the leaves totally leaving behind only the veins.

The modern researchers are now aware of the technology to exploit the toxic properties of some compounds found in plants, and use them against the pests.

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The modern researchers are now aware of the technology to exploit the toxic properties of some compounds found in plants, and use them against the pests.

One group of compounds that has demonstrated significant toxic effects on some pests have been discovered in neem tree (Azadirachta indica) (A. Juss). The most active constituent Azardiractin (AZA), a triterpenoid, has been shown to have properties including feeding and ovipositional deterrence, growth disruption, reduced fitness, disruption and sterility in a number of species of hemimetabolous and holome tabolous insects (Ascher and Meisner 1989, Shmutterer 1990).

Chinese used Pyriphorum a thousand year ago to control the insects. Thriving industry in Kenya today are producing these natural insecticides from Crysanthemum flower. Ancient persons used cinnamon, mustard and pepper products or insecticides and fungicides to protect their foods.

In fungus and insect pest control great emphasis is laid on their control rather than eradication. The efforts are being made towards the development of repellents, feeding deterrent, growth retardant etc. which are aimed to prevent, rather than to kill. Many plant materials serve as pesticidal or fungicidal substances. During storage, grains and pulses are liable to be infected by various pests resulting in qualitative and quantitative losses as observed by Vasantharaj David and Kumarswamy (1982). As already stated storage pests annually destroy approximately one third of the world's production of which highest losses (43% of production) occurs in developing Asian Countries. Sinha (1993) has estimated the loss ranging from 9% in development countries and upto 50% in some part of developing nations.

In their search for more selective methods of insect control the entomologists have tried to use pheromones, i.e. the attractants produced by insects, chemical repellents, which repel the insects from their food;

antifeedants, which hinder the feeding of insects; harmones – mimicking compound and some antimetabolitesl, which disrupt the developmental processes.

Chemical insect repellents also find practical applications in the protection of man and domestic animals against mosquitoes, flies etc. However, their usefulness in crop protection is yet unexplored. Recently some chemicals have been discovered which do not actually repel but, on ingestion serve as feeding deterrents since the host is not killed immediately. The predator do not suffer a set back. A synthetic compound (dimethyltriazeno) acetanilide has been found to be effective against a number of surface feeding insects on cabbage and cotton under field conditions (Atwal 1976).

Some chemical compounds have the same biological activity as the natural juvenile hormone. They are highly active in very small quantities and penetrate the insects cuticle just like the natural hormone and thus have great potential in insect – control. The application of these compounds in the larval stage prevents pupation of the last nymphal instar or in the prepupal stage. They are effective in controlling the insects of stored grain, since the juvenile hormone and its mimics are not structurally related to any of vertebrate harmones, they are safe for human beings. (A.S. Atwal 1976). Need of today is to have a multipronged approach of insect control so that farmer could select a method suitable to his conditions. Insect pest can broadly be controlled by various means like cultural practices, legislation, physical or mechanical control, Biological control, chemical control, use of resistant varieties, pheromones, sterilization techniques, harmons, antifeedants and genetic sterility etc. With the use of plant antifeedant we can be friendly with nature and at the same time we can develop methods for control of insect pest. These are safe, biodegradaible and at the same time easily available. This will

help farmers too by saving their crops and guide them for effective methods of pest control. Antifeedant plants selected for the purpose by the author were Azadirachta indica, Lantana camera, Ageratum conyzoides, Tridex procumbens and Parthenium hysterophorus after a priliminary trails with a number of plant species. These belong to the 3 different families. Astereraceae, Meliaceae and Verbenaceae.

The taxonomic identification of all the five plants were done with the help of recognized herbaria of Duthie, Hutchinson and Engler & Prantles as well as from the specimens preserved in the Harbarium of the Deptt. of Botany. These plants are being introduced below in their respective families with important medicinal properties.

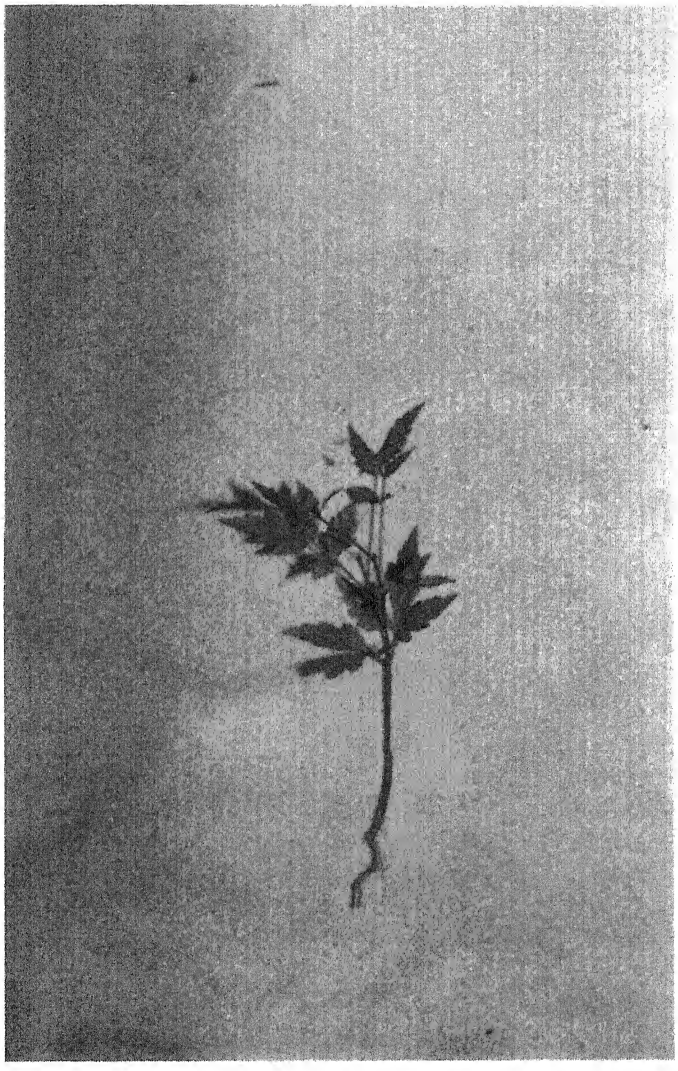
Family – Meliaceae – Azadirachta indica. A. Juss. Syn. Melia azardirachta Linn. (Plate no.1)

The family contains 50 genera and 1,400 species distributed exclusively in the tropical regions of the world. In India the family is represented by 19 genera and over 72 species occurring mostly in the peninsular India.

This is a genus of tall, evergreen trees, comprising two species. Azadirachta indica, native to India is now widely distributed throughout the Indomalayan region and is also found in tropical Africa. A. integrifolia Merril is indigenous to the Philippines.

Azadirachta indica grows wild in sub himalayan tract and forests of other areas. In India, it occurs in the tropical dry deciduous / evergreen and thorny forests and drier parts of Uttar Pradesh, Haryana, Punjab, Himachal

PLATE -1



Azadirachta indica A. Juss

Pradesh, Orissa, Andhra Pradesh, Kerala, Karnataka and Tamil Nadu up to 1500 m. altitude.

Melia azadirarchta Linn. Tree which runs wild in sub-himalayan tracts and commonly cultivated in India as an avenue tree. It is also grown as shade tree in tea and coffee plantations. It yields a valuable timber which is very hard of finely marked grains used for toys, cigar cases, agricultural implements, musical instruments and furniture. The leaves, bark and seeds have insect repellent properties. The plants also exude a useful gum. Plants are mostly trees with tap root system, stems are woody, aerial, erect, cylindrical, branched solid, older portion brown while younger portions minutely hairy, smooth and green. Leaf are cauline and ramal, alternate, exstipulate, leaf base pulvinus compound bipinnate and imparipinnate, pinnae ovate or lanceolate, coarsely serrate, glabrous, unicostate, reticulate veination, pinna base more or less oblique.

Inflorescence is axillary panicle cyme. Flowers are bracteate, bracteolate, pedicellate, pedicel long, complete, actinomorphic, hermaphrodite, pentamerrous or rarely, tetramerous, hypogynous and cyclic, Calyx have 5 sepals which are polysepalous, basally connate, valvate and hairy. Corolla are made up of petals 5 polypetalous, imbricate or quincuncial, purple.

Androecium – stamens 10, monoadelphous, forming a staminal tube enclosing the ovary tube, cylindrical, dilated at apex and base, apex ten toothed anthers are inserted near the apex dithecous, basifixed, introrse.

Gynoecium – 5 to 8 carpellary, syncarpus, ovary superior, 5-8 locular with one or two ovules per locule, placentation axile, style long and

slender, stigma 5 lobed, a nectariferous disc is present below the ovary. Fruit – Drupe

Floral Formula – Br, brl, $\oplus \varnothing \male K_5 C_5 A_{(10)}, G_{(5-8)}$.

Siddiqui, et. al. 1991 described five new terpenoids trirucalla – 7, 24 – dien –16 beta –0L (limocinol); trirucalla –8, 24 dien –16 one (limocinone); 24,25,26,27- tetranorapotirucalla – 7 alpha – acetoxy –21, 23 – epoxy – 21 alpha – Methoxy –1, 14 – dien –3- one – (limoun A); 24,25,26,27 – tetranorapotirucalla –7 alpya – acetoxy –21 – 23 – epoxy –20 xi –hydroxy 23 xi – methoxy –1, 14 – dien –3 one (limocinin) from fresh, uncrushed ripe fruit coatings of Azadirachta indica.

At least 65 patents has been filed on neem and its derivatives since 1985 by American, Japanese and European firms. Since its properties have been systematically studied within our indigenous knowledge systems, the claim to novelty are false, few examples are as follows - U.S. patent No. 4556, 562 for stable antipest neem seed extract by patentee Robert Larson, USA; Nickwood Ltd., now W.R. Grace and Co., NY, USA; Patent No. 4902, 713 for Azardirachtin like compound and insects destroying agents containing them by patentee Heinz Rembold et. al.,, Germany; Insecticidal hydrogenated neem extracts by patentee Zev Lidert, USA wide U.S. Patent No. 434; Method to prepare an improved storage stable neem seed extract by patentee James F. Walker, USA; W.R. Grace and CO., NY. USA. Patent No. 681; Slannin derivative insect control agents the patent no. 4960, 791 by patantee James A. Klocke et. al., USA; Storage Stable Azardirachtin formulation by patentee Charles G. Carter et. al.,., USA., Patent No. – 5001, 146; Azardirachtin derivative by Patentee James A. Klocke; Native Plant Institute (NPI), Patent No. 149; Dentrifice toothpaste using neem root and branches Patentee not

known; Floss products Corp., Illinois USA Patent No. 886; Neem Oil, emulsifier patentee not known, PPG Including. Dennsylvannia, USA Patent No. 591; Method for controlling fungi on plants by the aid of hydrophobic extracted neem by Patentee James Charles Locke, Hiram G. Larew III, USA, Patent No. 257 B1; Hydrophobic extracted neem oil – a novel insecticide by patentee James C. Locke, James F. Walter et. al.,; Patent No. – 612. Fungicidal compositione derived from neem oil and neem wax fractions by patentee John C. Locke, James F. Walter, Hiram G. Larew III, NY, USA, Wide US Patent No. 5409, 708 are false.

The seeds are the source of margosa oil which is used in skin diseases, applied as a linament in rhevmatism and possesses antihelmintic and insecticidal properties. It is also used in the manufacture of bathing soaps and tooth paste. Naumann, K. & M.B. Isman. 1995 studied the evaluation of neem Azadirachta indica seed extracts and oil as oviposition deterrents of Noctuid Moths. Schmutterer H. 1986 found fecolundity reducing and sterilizing effects of neem seed kernel extracts in the colorado potato Beetle, Leptinotarsa decemlineata. Schmutterer (1990) worked on the properties and potentials of natural pesticides from the neem tree Azadirachta indica.

Azadirachta indica Juss Syn. Melia azadirachta L. (Neem, Margosa). It is a common tree. Almost every part of the plant has found application in indigenous systems of medicine. The seeds are the source of margosa oil which is used in skin diseases, applied as a linament in rheumatism and possesses antihelmintic and insecticidal properties. The oil cake is a useful fertilizer. The bark is very bitter and is beneficial in malaria fever. The leaves are bitter and posses insecticidal properties. The dry flowers are tonic and stomachic. The tender twigs are used to clean teeth and very effective in pyorrhoea. The wood resembles mahogany and is suitable for carving, house building and agricultural implements.

Family Asteraceae – Parthenium hysterophorus L, Tridex procumbens L, and Ageratum conyzoides L. :-

The Asteraceae is one of the largest family of the flowering plants, comprising about 950 genera and over 19,000 species. They form more than ten percent of the total number of species of flowering plants. They are distributed throughout the world inhabiting every conceivable situation. In India the family is represented by about 138 genera and 708 species extending in the Himalayas and the mountains of Southern and Western India up to about 6,000 meters.

Economically the family is of considerable importance specially as sources of food suppliment to man. The insecticide pyrethrum is obtained from Chrysanthemum coccineum. Many members are noxious weeds and others are used to limited extent in medicinal or patented preparations. A large number of genera have proved quite promising against insect pests and are used as biopesticides. Gajendra (1980) reported antifeedant activity of Parthenium hysterophorus L. against Spodoptera litura L. Nowerot et. al. (1982) have reported that plant extracts of family compositae containing constituents of sesquiterpene lactones persisted the greatest antifeedant activity against Callosobruchurs chinensis L. a stored grain pest.

A sesquiterpene lactone from Encelia actoni reported by Shrivastava et. al., (1990) showed antifeedant and insecticidal activity against Spodoptera littoralis Hausen et. al. (1991) also reported α - peroxyachifolid a sesquiterpene lactones from Achilliea millefolium a member of family : Asteraceae. The Ageratum conyzoides L. an indigenous plant have been reported by Saxena and Saxena (1992) as a growth inhibitor against

mosquitoes. Singh et. al., (1988) have reported the antimicrobial principle in Sphaeranthus indicus L. which is the member of family Asteraceae. Fungitoxic activity of Parthenium hysterophorus was reported by M.K. Rai (1993).

Pathak and Dixit (1988) reported that the essential oils from Tridex procumbens and Cyathocline lyrata exhibited strong insecticidal activities against Musca domestica, Culexfatigans, Dysdercus similis and Supella spp. Insecticidal activity of Ageratum conyzoides were recorded by Bhathal et. al. (1994); Shrivastava et. al. (1995) & Gupta (1996). Biological activity of Sphaeranthus indicus was recorded by Baby (1994), Shrivastava et. al. (1997).

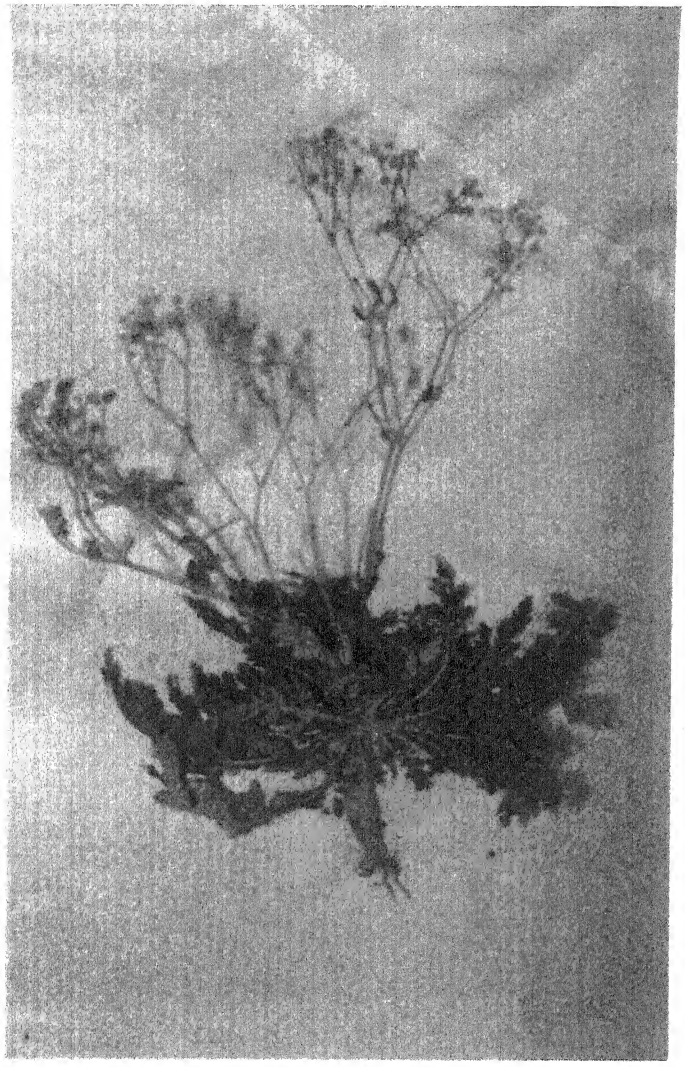
Parthenium hysterophorus:-

Parthenium hysterophorus is a native of West Indies and Central and North America. This exotic weed is now naturalised and found throughout the plains of India. (Plate no. 2)

Plants are annual herbs with tap root system. Generally growing wild along road side and open fields under mesophytic conditions during rains and winter. Stem is erect branched, herbaceous, cylindrical, furrows and ribs present, solid, hairy, green in colour. Leaves are simple, opposite decussate, pinnatifid, petiolate and highly dissected with acute apex and unicostate reticulate veination.

Inflorescence is capitulum, capitula arranged in monochasial cyme. Involucre present. Flower in the head are heterogamous, 5 rays florate in the peripherial region with many disk florates in the centre.

PLATE-2



Parthenium hysterophorus L.

Ray florets are bracteate, sessile, tubular, ligulate, zygomorphic, unisexual and in complete, pistillate and epigynous. Calyx are 2-3 pappus. Corolla are 2-5 gamopetalous ligulate, white. Andoecium is absent. Gynoecium have 2 carpels, inferior ovary with basal placentation style one stigma bifid.

Disk florets are Bracteate, sessile, bisexual complete, actinomorphic, epigynous. Calayx are 2-5 pappus. Corolla have 5 petals and gamopetalous, tubular. Androecium have 5 stamens, syngenecious, epipetalous, bilobed and introse. Gynoecium have 2 carpels, syncarpous, inferior ovary, basal placentation and one style, stigma bifid. Fruit is cypsella.

Floral formula :- Ray florate - %, ♀ $K_{2\text{-}3(\text{pappus})}\ C_{(2\text{-}5)}, A_{(0)}, G\ \overline{(2)}$.

Disk floret :- $\oplus, \varnothing, K_{2\text{-}3\ (\text{pappus})}, \overset{\frown}{C_{(2\text{-}5)}\ A_{(5)}}, G\overline{(2)}$.

This plant is used as tonic, febrifuge, emmenagogue and analgesic. The decoction of the root is given in dysentry.

The field studies indicates Parthenium hysterophorus extracts were useful as additive to conventional insecticides to manage the insecticide resistant cotton ballworm (Helicoverpa armigeral) Venugopal et. al., 1993.

The methanolic flower extract of (Parthenium hysterophorus) has been found to have antitumor effects in host mice bearing transplantable lymphocytic leukemia by Mukharjee & Chatterjee 1993. Role of Parthenium hysterophous pollen extract as an allergen evoking bronchial hyperresponsiveness among bronchial asthma patients was assessed by Suresh et. al., 1994. Martinez – Vazouez et. al., 1994 found that Argentatine A

isolated from Parthenium argentatum exhibited marked in vitro antibacterial activity against several pathogen bacteria.

Sinha & Singh 1990 found cent percent mortality in tadpoles in 0.2% aqueous leaf extract after 3 hours however, he found lesser degree of toxicity from extracts of floral parts.

Tridex procoumbens L. :-

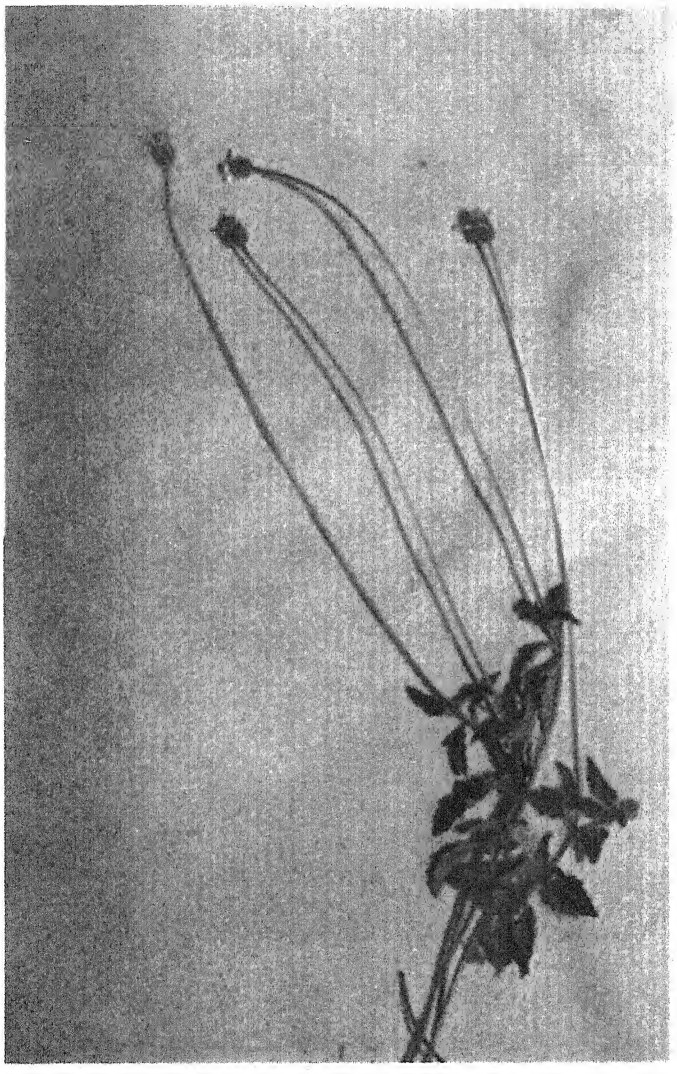
Plants are mostly prostrat annual herbs growing wild along road sides specially during rainy and winter season. Stem is herbaceous, cylindrical, hairy, green. Leaves are simple, opposite supperimposed, exstipulate, petiolate, ovate, dentate or serrate margin, acute apex, unicostate, reticulate veination, hairy surface. (Plate no. 3)

Inflorescence is capitulum, surrounded by an involucre of bracts. Flower are heterogamous small size, Ray florets are legulate and disk florets are tubular.

Ray florets are bracteate, sessile, incomplete, unisexual and epigynous. Calyx are 2-5 hairy pappus. Corolla are 5 petals, gamopetalous, ligulate, volvate aestivation and white. Androecium is absent. Gynoecium is bicarpellary, syncarpous, unilocular, inferior, basal placentation, style long and stigma bifid.

Disk florets are bracteate, sessile, bisexual, complete, actinomorphic and epigynous. Calyx are 2-5 pappus. Corolla are five petals, gamopetalous, tubular, actinomorphic, volvate aestivation and yellow. Andoecium have five stamens, syngenesious, epipetalous, anthers dithecous

PLATE - 3



Tridex procumbens L.

and introrse longitudinal dehiscence. Gynoecium is bicarpellary, syncarpous, inferior ovary, unilocular, basal placentation, style long and stigma bifid. Fruit is cypsella.

Floral Formula :-

Ray florets :- Br, %, ♀, $K_{,(pappus)}\ C_{(5)},\ A_0,\ \underline{G_{(2)}}$.

Disk florets :- Br, ⊕, ♂♀, $K_{(pappus)}\ \overset{\frown}{C_{(5)},\ A_{(5)}},\ \underline{G_{(2)}}$.

Leaves are used in the treatment of bronchial catarrh, dysentery and diarrhoea. Leaf juice is insecticidal and pesticidal and can also be used to check haemorrhage.

The essential oil isolated from flowers of Tridex procumbens was tested by Dixit and Sarai 1989 against two storage grain insects Calandra granaria and Tribolum confusum for insect repellent activity. Effective repellent action at 10 ppm concentration was seen.

The oil was also tested by the above worker against Disdercus similis at different instar stages to study its effect on moulting hormone activity. The essential oil strongly inhibited normal moulting of the nymphs and caused deformation in wings, legs, obdominal segments and mouth parts, which were ultimately fatal to insects.

The ethanolic extract of (Tridex procumbens) was studied by Pathak et. al., 1991, for its hepatoprotective action against CCl_4, demonstrated antihepatotoxic action just find its use in liver infections.

Saraf et. al., 1990 studied the topical application of fraction of petroleum ether extract of Tridex procumbens. They found remarkable effects on metamorphosis of Dysdercus while generating abnormalities in adults.

Ageratum conyzoides L. :-

Commonly called as goat weed (koobhi in Hindi) is a native of south America now well naturalised throughout India, very common in wastelands, roadsides and cultivated fields upto 1800 m height. A genus of aromatic herbs, comprising 45 tropical species. (Plate no. 4)

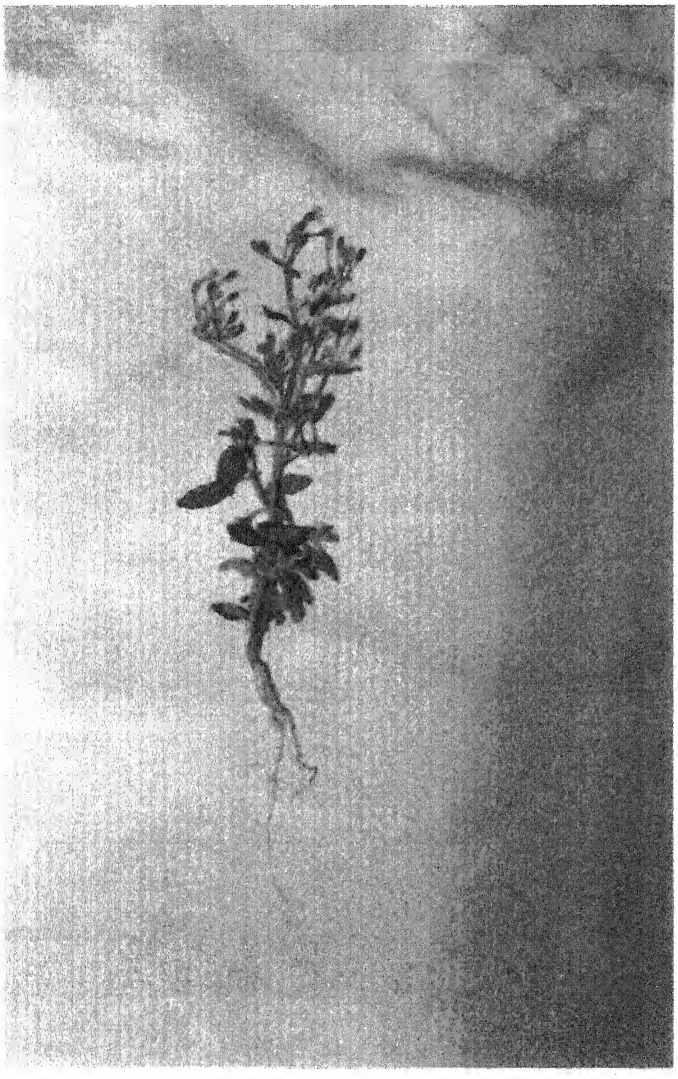
This plant is an annual herb with tap root system. It is also a wild plant which could be easily obtained from mesophytic habitat. Its stem is erect, branched, herbaceous, cylindrical, solid, profusely hairy. Leaves are simple, opposite below and alternate above near the inflorescence, petiolate, exstipulate, ovate, cuneate (wedge shaped) to subcordate at the base, unicostate reticulate veination.

Inflorescence is capitulum with large number of capitula arranged in dense terminal corymbs. Flower are homogamous, all flowers being tubular and hermaphrodite, bracts green, linear, receptacle flat or almost so, epigynous and violet or bluish – violet in colour.

Calyx is absent as such, but represented by five scaly structures. Which are awned or barbed pappus. Corolla have five petals, gamopetalous tubular violet or bluish violet, superior, volvate aestivation.

Androecium of five stamens, epipetalous syngenesious, anthers introrse and appendaged with bases obtuse. Gynoecium are bicarpellary,

PLATE - 4



Ageratum conyzoides L.

syncarpous, ovary inferior, unilocular with basal placentation. Fruit is cypsella.

Floral formula :- Br,⊕,☿, $K_{5(pappus)}$, $\overbrace{C_{(5)}\,A_{(5)}}$, $G_{\overline{(2)}}$.

Its roots and leaves are used as antilithic and antiseptic respectively. It shows many biological activities, such as insecticidal, antifungal and antibacterial.

Family – Verbenaceae - Lantana camera L. :-

It is a large family of 77 genera and 3,015 species, distributed mostly in the tropical and subtropical regions. In India the family is represented by about 21 genera and 125 species, occurring mostly in the southern and western India and in the tropical and subtropical Himalayas. The familiar examples are Teak (Tectona grandis L.), Verbena (Verbena Spp.), Lantana (Lantana Spp.) and Glory bower (Clerodendron). (Plate no. 5)

Lantana camera plants are perennial shrubs with tap root system. Stems have herbaceous upper portion while the lower portions are woody, aerial, erect, quadrangular, branched, solid, hairy with some recurved spines, green. Leaves are cauline and ramal, opposite decussate, exstipulate, simple, petiolate, ovate, serrate, acute apex, unicostate, reticulate veination, surface rough and texture coriaceous.

Inflorescence is axillary corymbose cyme. Flowers are bracteate, bractiolate sessile, hypogynous, hermaphrodite, complete, pentamerous, zygomorphic and cyclic. Calyx of 5 sepals, gamosepalous, volvate. Coralla are petals 5, gamopetalous, quincuncial, aestivation, corolla 4/1 bilipped, one

PLATE - 5

Lantana camera L.

anterior petal is large and pointed, the petals are variously coloured, coronary outgrowths present at the throat of the corolla.

Androecium have stamens 4, situated in the throat of the corolla, polyandrous, epipetalous, didynamous, dithecous, adnate and introrse. Gynoecium are bicarpellary, syncarpous, ovary superior, bilocular, with one ovule in each locule, placentation axile, style simple, stigma knob like. Fruit is Drupe.

Floral formula :- Br, brl, %, ♀, $K_{(5)}$ $\overset{\frown}{C_{(4/1),}}$ $A_{2+2,}$ $G_{(2)}$.

Lantana camera L. is regarded both as a notorious weed and a popular ornamental garden plant. The plant has various uses in folk medicine in many parts of the world. Some taxa of the widely variable Lantana camera complex are toxic to small ruminants and this effect has been associated with the types and relative amounts of some triterpene ester metabolites. However Lantana camera also produces a number of metabolites in good amount, while some have been shown to possess useful biological activities.

Lantana spp. toxicosis with reference to liver stock morbidity has been discussed by Gadre 1991 for its impact on livestock rearing, chemistry of the toxins and allelochemicals, molecular mechanism of action and combat strategies.

Lantana camera creates problems of fodder in porks. The thick bushes of Lantana prevent the seeds from reaching the ground and hence the rejuvenation of the trees get adversely affected. Lantana is known of widespread menace of weeds. Lantana can be used for creating furniture which comes out to be much cheaper than cane furniture. In addition to this

Lantana are also mosquito repellants. Lantana is helpful in preventing soil erosion.

Systematic Position and Distinguishing Characters of Callosobruchus chinensis Linn:-

Phylum	-	Arthropoda
Class	-	Insecta
Order	-	Caleoptera
Sub – Order	-	Polyphaga
Family	-	Bruchiae
Genus	-	callosobruchus
Species	-	chinensis Linnaeus

Callosobruchus chinensis Linnaeus has been reported from the USA, Mauritius, Formosa, Africa, China, Philippines, Japan, Indonesia, Sri Lanka, Burma and India. It is notorious pest of gram, mung, moth, peas, cowpeas, lentil and arhar. It has also been reported on chick pea (gram), cotton seed, sorghum and maize.

Egg :-

Female lays oval, scale like eggs which are attached with the grains. The rate of egg laying is 1-70 per day and a single female can lay 34 to113 eggs in all with in twentysix days. (Plate no. 8)

Larva :-

The eggs after incubation of 7 to 14 days at different conditions are hatched out into larvae which bore into the grains and complete their

development inside. Full grown larva is 6 to 7 mm in length with light brown coloured head and later on it acquires a creamy hue. (Plate no. 9)

Pupa :-

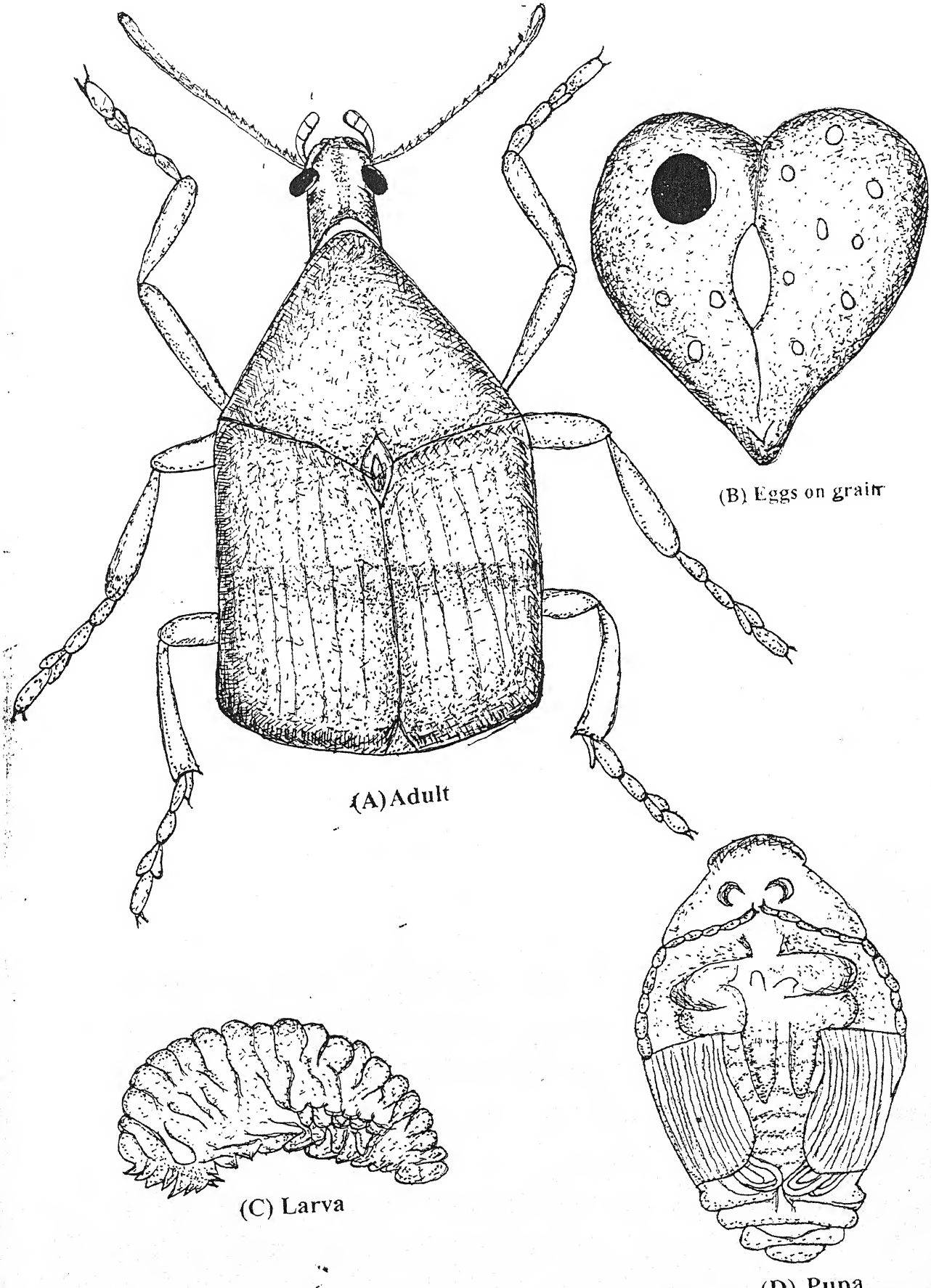
The larva after 10 to 12 days in August – September gets changed into a white coloured oval shaped pupa.The pupa after 4 to 28 days emerges after cutting a circular hole in the seed coat. (Plate no.10)

Adult :-

The adult frons with 3 pairs of setae and a pair of pits. Anteclypeus with a pair of sensory pits at the base of basal setae, labrum conical. Terminal setae of antenna two and half times as long as apical papilla, premental sclerits truncated poteriorly. Lingula with a pair of setae and a few spines. Adult just after emergence copulate and fertilize. (Plate no.1)

Life Cycle :-

The pest breeds actively from March to the end of November. It hibernates in winter in the larval stage. In the end of March, the adults appear and copulate immediately after emergence. A day later, the female starts laying small oval, scale like eggs which are glued to the grains. In this spp. more than one egg may be laid on a grain. Thus two or three (upto 8 have been reported on a single grain) larvae may develop in separate chambers. A single female of Callosobruchus chinensis may lay 34-113 eggs at the rate of 1-37 per day. The highest egg production is in May and October and the least in April, June, July and December. The eggs hatch in 7-4 days in April 4-6 days in September and in 8-16 days in November. The viability of the egg varies from 3.6 percent in May, to 76.9 percent in August and September. The young larva bores into the grain and completes its development inside. The



Different stage of Callosobruchus chinensis : (a) Adult
(b) Eggs on grain (c) Larva (d) Pupa

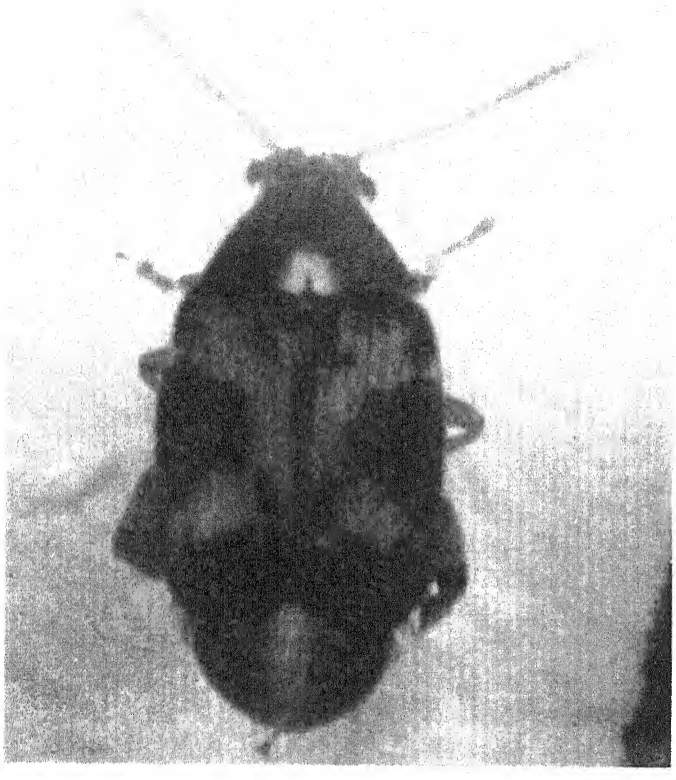
larval stage is completed in 10-12 days in August and September and in 26-38 days in November. The hibernating larvae take 117-168 days to complete their development. The full – grown larva migrates towards the periphery and comes to lie – next to the seed coat, where it turns into an oval white pupa. The pupal stage lasts 4-28 days depending upon the season. The adult escapes by cutting a circular hole in the seed coat and such grains can be spotted easily. The average life span of an adult is 5-20 days. A preponderance of males occurs throughout the active season. The insect passes through 7-8 overlapping generations in a year. Infected grains by Callosobruchus chinensis (Plate no. 7)

Damage :-

The damage is at its peak from April to September and is considerably reduced in October – November. The damage to pulses infested with this insects is very high and quite often each and every grain is infested. Naturally, the pulses after severe infection become unfit for human consumption; Infested grain is often converted by the trader into flour which has a characteristic off flavour.

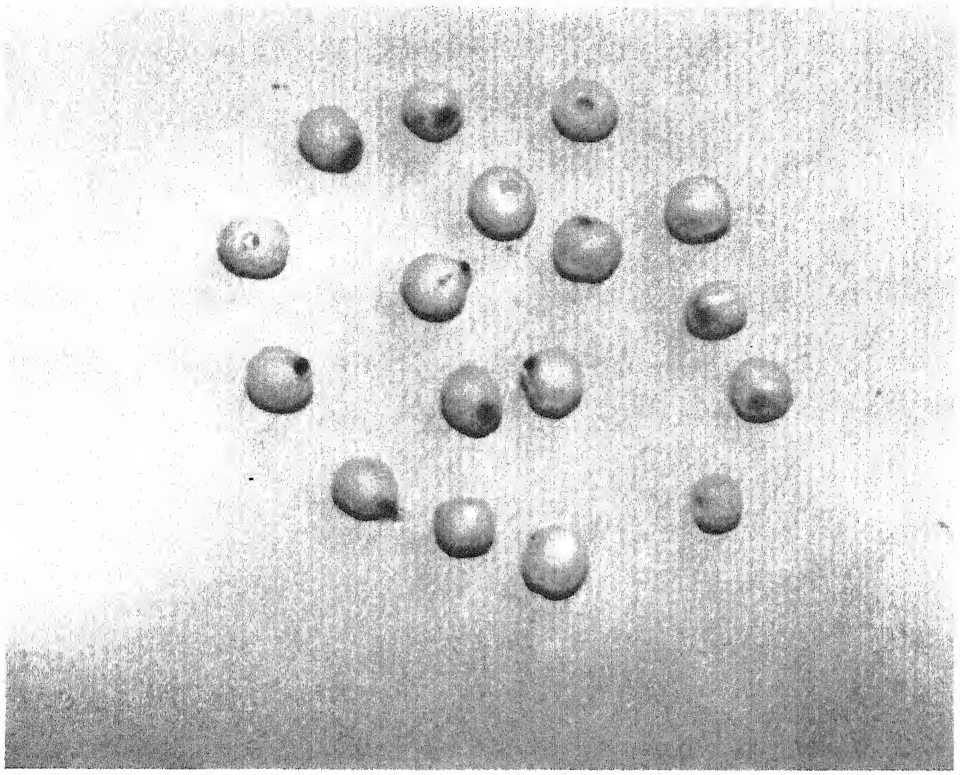
Cereals used for fungus and insect pest control during storage. A number of cereals suffer from fungus and insect pest during storage. Their loss during storage has already been reffered in the previous text. At Jhansi during storage heavy losses have been reported for phaseolus radiatus (urd) Phaseolus mungo (mung), Lens esculenta (masur) Cicer areitinum & Cicer kabulicum (blackgram, whitegram) in godowns and grain merchants. Hence these cereals were used with a view to protect them against fungus and insect damage. In the following text each of these cereal in being introduced wih their local names and importance.

PLATE - 6



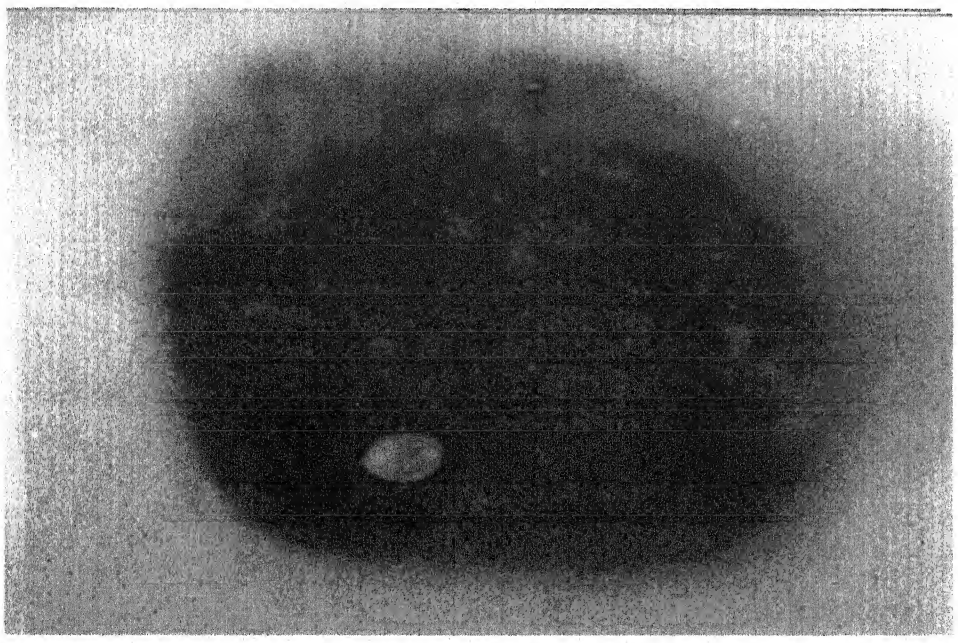
Adult of Callosobruchus chinensis

PLATE - 7



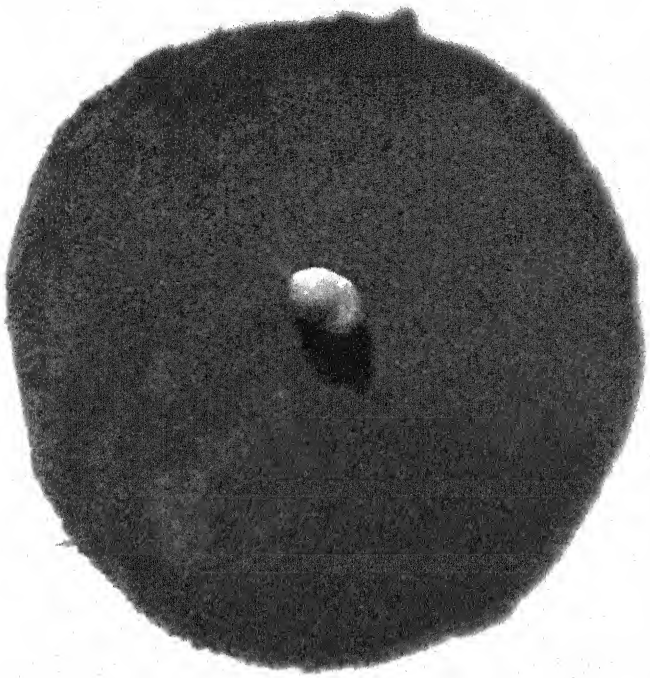
Infected grains by Callosobruchus chinensis

PLATE -8



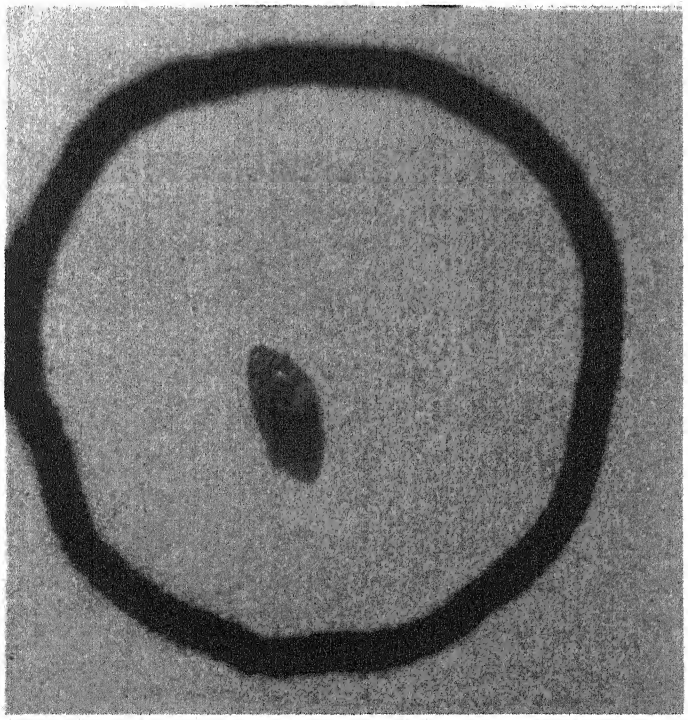
Egg of Callosobruchus chinensis on cereals

PLATE - 9



Larval stage of Callosobruchus chinensis

PLATE -10



Pupal stage of Callosobruchus chinensis

Phaseolus radiatus (Urd)-Belongs to the family Leguminosae; sub family papilionaceae named as V. mungo (Linn) Hepper Syn. Phaseolus radiatus Roxb. non Linn.; P. mungo Linn., non Roxb. & auct. According to the latest works published in CSIR publication (1956) Phaseolus radiatus is used for Urd.

Local name -

HINDI- Urd ; BENG,- Mash-kalai; GUJ- Adad., Arad; MAR- Udid, Maga; TEL,- Minumulu, Karuminimulu, Nallanminumulu; TAM.- Ulundu; KAN- Uddu; MAL.- Uzhunnu..

A genus of erect, hairy plant with a height varying from 30 to 90 cm, cultivated throughout India. Leaves trifoliate; leaflets entire, ovate with acuminate apex, 5-10 cms long; flowers small, yellow pedicellate, pods cylindrical, erect hairy with hooked beak, 3.75-4.35 mm long seeds usually 4 or less than 4 oblong quadrangular generally black, white hilum protruding from the seed.

The plants are largely cultivated in upper gangetic plains and form the most highly valued of all the phaseolus Pulses. Two distinct varieties are cultivated, one with large black or dark brown seeds which ripens in August – September and the other with smaller greenish seeds which ripens in October-November.

The grains are extremely nutritious and are largely eaten by all classes of people. According to Duthie, the seed has the reputed origin of the weight known as Mash, 12 of which form the Tola, and 480, a pound.

The seeds are used both internally and externally in paralysis, rheumatism and infections of nervous system. They are useful in piles, infections of the liver and cough.

Phaseolus mungo auct., Non – Linn. :- (Mung) :-

Named as V. radiata (Linn.) Wilczek Syn. Phaseolus radiatus Linn., non Roxb. & auct; P. aureus Roxb.; P. mungo auct., non Linn.. According to the latest works published to CSIR (1956). P. mungo is used for mung.

Local Name :-

HINDI – Mung, pessara; BENG. – Mung; MAR. – Mug; GUJ. – Mag; TEL – Uthulu, patchapessalu; TAM. – Pasi – payaru, putcha – payaru; KAN. – Hesaru; MAL. – Cherupayaru.

It is an erect or sub-erect annual herb cultivated almost in every part of India. The plant has a height ranging from 45-120 cm. Leaves trifoliate; leaflets entire, ovate, rarely trilobed. Flowers yellow and in clusters of 10-25 pedicellate flowers. Pods 5.5-10.0 cm long cylindrical, seeds more or less globular, green in color sometimes become blackish green, brown or purple brown, hilum flat covered with a white rough layer.

Mung is supposed to be a native of India and Central Asia (The Wealth of India 1976). The crop prefers deep and well drained loams.

The plants are generally cultivated as a rainy season crop but in some parts i.e. Gujarat and Maharashtra it is sown as a cold season crop. There are number of varieties which are distinguished by the colour of their

seeds (Green, Yellow or black). The seeds (grains) are extremely nutritious and are largely eaten in form of dal. They have a cooling effect and are often used as a diet after fever and to strengthen the eyes.

Cicer areitinum L. :-

These are cultivated in our country during winter months. The seeds are obovate or sub globose, beaked, reddish brown, black or white. "Cicer kabulicum" is the larger white seeds species.

Local Name :-

HINDI – Chana, gram pea, ENG – Chick pea.

A large number of strains and varieties are grown. Its variety "Kabulichana" with large white seeds are used for some edible preparation. Gram is next to wheat as a food crop and for diabetic patients. The stalks and leaves after the grain is removed form a valuable fodder for cattles and other animals.

Lens esculenta Moench :-

This is the oldest pulse's crop of ancient Greece Egypt and India.

Local Name :-

HINDI – Masur, ENG – Lentil.

The plants are largely cultivated as a cold weather crop through out India. It is considered as one of the most important pulses. It is eaten as a dal.

The seeds are mucilaginous, laxative and useful in constipation and other intestinal disorders. When made into a paste, it is applied in ulcer.

These seeds bear surface microflora on the seed coat as well as with in the seeds. These micro-flora, when get suitable conditions become active, their resting mycelium or spores germinate and infest the seeds, causing considerable damage during storage. These surface flora of the seed coat are also responsible for several seed born diseases, which have been isolated and identified, Suryanarayana and Bilgrami et. al., (1979-81). To avoid storage loss by fungal organisms a number of organic, inorganic, fungicides are used. Seeds treated with these fungicides cause hazards to the environment and at the same time may effect the health of the consumers, thus attempts have been made to find out some plant materials which could act both as a fungicide as well as an insecticide. Joshi and Singh 1969, reported Botrytis cinerea from Panthnagar (U.P.). Patel et. al., 1949, reported Oidium species. from Puna. Maharastra, while Uppal et. al., 1935, reported Pellicularia filamentosa from Bombay on Cicer areitinum seeds. Some new reportes for the occurrence of Colletrotrichum dematium from Jabalpur (M.P.) has been given by Mishra et. al., 1975, and of Pellicularia rolfsii has come from Rajendra and Pavgi 1967. New reports have also arrived for Alternaria species from Hyderabad by Haware and Nene 1976 and Pellicularia rolfsii from West (U.P.) by Upadhyaya and Pavgi 1967.

All these fungus have been obtained from Cicer areitinum. On Phaseolus mungo seeds Cercospora kikuchii, Fusarium longipes, Stemphylium species Verticillium cinnabarinum has been reported by Agarwal et. al. 1972, from Panthnagar (U.P.).

From seeds of Phaseolus radiatus Alternaria tenuis has been reported from Bombay by Rao 1965; Colletotrichum lindemuthianum from South India by Rangaswami et. al. 1970; Sclerotinia sclerotiorum from Jorhat Assam by Roy 1973 and Pellicularia filamentosa by Uppal et. al., 1935 from Bombay.

Plants considered to be antifeedant contain certain trepenoids flavonoids and phenolic substances which have been shown to be reponsible for antifeedant activity. These substance has been isolated by various workers through spectroscopic, NMR and other methods.Some diterpenoids have been isolated from Azadirachta indica by Ara et. al., 1989; Siddiqui et. al., 1991 from Pakistan; Ara 1990 reported three new Tricyclic diterpenoids; Siddiqui et. al., 1988, Majumder et. al., 1987 reported a modified diterpenoid from the root bark by spectroscopic method from West Bengal; Ara et. al., 1990 reported new tricyclic diterpenoids; Kumkum Rani and Akhila 1994, has isolated apotetracyclic triterpene from the leaves of Meliaceae. Azadirachta indica from Lucknow; Ara et. al., 1992 by isolated from stem bark of Azadirachta indica; some new tetranortriterpenoid named as nimbolicin has been isolated from Azadirachta indica by Ara et. al., 1989. Ara et. al.,1990, isolated new triterpene by spectroscopic methods. Siddiqui et. al., 1991-1992 isolated triterpenoids from the fruit coats of Azadirachta indica ; Govindachari et. al., 1992 isolated new tetranotriterpenoid from Azadirachta indica ; Siddiqui et. al., 1989, Rajatkar et. al., Siddiqui et. al., 1986-1987, Mahato et. al., 1987, Kraus et. al., 1987, Sankaram et. al., 1993, Govindachari et. al., 1992 isolated tetranortriterpenoids from Azadirachta indica. These have been isolated from either acidic fraction of the fresh leaves from etholic or other solvent extracts like petroleum ether, methanol etc.

Parthenium hysterophorus is also considered as antifeedant plants and its inhibitory effect is attributed to the presence of certain terpenoid flavoinoid substances which have been identified by various persons through NMR, Spectroscopic or HPLC procedure. Its quantitative determination has been done by some persons through TLC methods Gromek et. al., 1991; Its sesquiterpene Lactone has been worked by Nayar et. al., 1990, Kuldeep Singh et. al., 1991, Heubl et. al., 1988. Sharma and Bhutani 1988 studied its antiamoebic activity; Awang et. al., 1991, Dodman et. al., 1992, Fontanel et. al., 1990, Brown 1993 found antiinflamatory properties of these sesquiterpene lactone parthenolide from Tanacetum parthenium. Williams et. al., 1995 isolated a new lipophilic flavour of called tanetin which could contribute to the anti inflamatory properties.

Terpenes are also isolated by Verma and Gupta 1988 from Tridex procumbens. Dixit and Sarai 1989 have found insect repellent activity of essential oils obtained from Tridex procumbens on store grain insects; Saraf et. al., 1990 have found insecticidal activity of its petroleum ether extract; Udupa et. al., 1991 have found the medicinal importance of Tridex procumbens on wound healing; Pathak et. al., 1991 have found other medicinal uses of Tridex procumbens as hepatoprotective; Saraf et. al., 1991 have given its ethanolic extract importance on hair growth promoting activity; Kinungo et. al., 1992, have shown that Tridex procumbens has anticoagulating activity; Saraf et. al.,1992 suggested hepatoprotective activity of Tridex procumbens ethanolic extract.

Azadirachta indica leaves, seed and bark extract and powder were found to be effective against insects pest of stored wheat, Mukherjee et. al.,. 1990, Ahmed 1988; Methanolic neem extract has shown high toxic effects on Anopheles and culex larva, Matemu and Mosha 1986; Neem oil has

mutagenic effect on Salmonella typhimurium as reported by Polasa and Rukmini 1987; Its role on reducing larval population on pest infesting Cicer areitinum has been shown by Sinha and Mehrotra 1988. The oil has also been reported to reduce the fertility rate in rats and rabbits by Sharma et. al., 1987; Its petroleum, chloroform and water extracts has been found to be toxic on mosquito larvae by Singh and Kataria 1985. The bark of Meliaceae, Azadirachta indica contains high oil content upto 17.5 percent has reported by Subramanian and Lakshmanan 1993. Its methanolic extract has great fungicidal activity as reported by Steinhaver, B. 1993; Its petroleum ether extract has insecticidal properties against mosquito and housefly as reported by Deshmukh 1993; its powder has been found to be effective in the control of root – knot of ginger, Dohroo and Khan 1993. Neem oil has protective activity of stored grains and woollen clothes as suggested by Gujar 1993. The ethanol extracts of neem was found to have growth regulatory activity against Tobacco caterpillar, Spodoptera litura as suggested by Prabhu and Singh 1993; Salla 1993 used neem seed extract to control the growth of Millet head worm; Sehgal and Singh 1993, found strong feeding deterrency of neem aqueous extract in 2 percent concentration against flies.

Srivastava et. al., 1993 found its oil effective against mangohoppers; Neem oil was found to effective against ricehispa by Baitha et. al., 1993; Tiwari 1992 published a monograph and reffered pest management by neem; Singh 1994 reported the effectiveness of ethanolic extract of neem leaves against skin disorders like eczema, ringworm and scabies; Srivastava et. al., 1986 inhibited the transmission rate of cucumber mosaic virus by 0.5 percent water emulsion of margosa oil. Balasubramanian et. al., 1993 was isolated a new flavonone from acetone extract of Azadirachta indica.

With the above facts in mind the present research has been undertaken to find out the various repellency, antifeedancy, insecticidal and fungicidal properties of indegenious plants widely growing in Bundelkhand region has been screened so that we could find out plant material which could substitute the synthetic substance and could be used both as antifeedant and antifungal materials. These material could be ecofriendly as well as easily available to the farmer for storing their valuable food grains. So far no works of any significance has been done in this respect hence with this view the work has been planned on the following lines.

Section 1 – INTRODUCTION :-

Includes generla introduction of the work plan, seeds & plant to be used and some work done on the related lines.

Section 2 - REVIEW OF LITERATURE :-

This section dealers with available literature in the subject and the work done in related field.

Section 3 – MATERIALS AND METHODS :-

This section dealers with the materials involved during the study period in the methods used for the analysis of the research work. This section has been divided into the following four chapter.

CHAPTER 1

Collection of Experimental Materials :-

In this chapter methods used for the collection of plants and methods used for preparation of extracts form water and different solvent both

by cold and hot percolation has been described together with extraction of oils from plants and the procedure to raise the lab culture of Callosobruchus chinensis has been described. This chapter includes four Exercise.

Exercise 1 – Collection of plant materials.

Exercise 2 – Preparation of water and solvent extracts.

Exercise 3 – Extraction of essential oils.

Exercise 4 – Laboratory culture of Callosobruchus chinensis.

CHAPTER 2

Bioassay test :-

This chapter includes experiments conducted on Callosobruchus chinensis for antifeedant and protection activity which include preliminary screeing from powdered plant material, composite powder sample, disttilled water extract, cold and hot sovlent extracts and essential oil. The chapter has the following exercises.

Exercise 5 – Preliminary screening from various powdered materials against Callosobruchus chinensis.

Exercise 6 – Protectant activity of selected powders plants materials.

Exercise 7 – Protectant activity from composite samples of selected plants powders.

Exercise 8 – Protectant activity of selected plants disttiled water extracts.

Exercise 9 – Protectant activity of selected plants cold solvent extracts.

Exercise 10 – Protectant activity of selected plants hot solvent extracts.

Exercise 11 – Protectant activity of selected plants essential oils.

CHAPTER 3

Phytochemicals Studies :-

This chapter includes methods used for purification and isolation of active principle by chromatographic methods there protectant activity and structural elucidation has been described. The chapter has the following exercises.

Exercise 12 – Purification and isolation of active principle.

(a) Paper chromatography.

(b) Thin Layer chromatography.

Exercise 13- Structural elucidation of biologically active compounds.

Excercise 14 – Protectant activity of Isolated principles.

CHAPTER 4

Mycological studies :-

This chapter includes methods media used for the isolation and identification of the surface fungal flora of cereals and there antifungal test against the selected plant extract. This chapter has the following exercises.

Excercise 15- Isolation and Identification of surface fungal flora from experimental cereals.

Excercise 16 -Test for antifungal activity of plant water extracts.

Section 4 – OBSERVATION RESULTS AND CONCLUSIONS :-

This section includes the observation of experiments conducted with the results and the conclusions obtain from various experiments.

Section 5 – SUMMARY AND DISCUSSION :-

This section includes the general summary of the various experiments and the results obtained has been discussed with reference to those obtained by other workers in the field.

Section 6 – BIBLIOGRAPHY

Section 7 – MISCELLANEOUS

- Published Reprints

SECTION 2

REVIEW LITERATURE

REVIEW OF LITERATURE

India is a vast and highly populated country which is next only to China in the total population. The crop yield is also less than most of the developed countries. Which is very much required for feeding, such a huge population. These food grains require storage for their use during off season. During storage enormous quantity of this valuable yield is lost by insect pests. Ahamed and Grainage (1986) has estimated that the post harvest loss in up to 50% in developing country. Normally insecticides are used to protect these insect pests during storage. Chapman 1979 found the chemical inhibition of feeding by phytophagous insects.

These chemicals are lethal and by themselves have harmful effect on the feeding population. Many of these chemicals spray on plants cause air pollution and at the same time results in the development of resistant type of insects. In India there is an urgent need to develop alternative substances, which could protect the plant and store food grains, so that the purpose of protection of crop may be fulfilled and at the same time may not disturb the ecosystem. The present work was thus aimed with this in mind and at the same time to get easily available biodegradable substances. Which could be cheaper, ecofriendly and easily available to the farmers and seed grainaries. India has vast vegetational resources. These could be expolited to get antifeedant plant materials. During the earlier period Azadirachta indica leaves were used to store food grains. Plant materials have been analysed by number of workers but from a different angle.

In this region of Bundelkhand seeds of Urd, Mung, White gram, Black gram and Lentil are generally infested by Callosobruchus chinensis. This insect pest destroy the seeds, during storage. Rajak and Pandey 1965 studied the various stages of the insect which occurs during its multipication within the seeds of Cicer areitinum. They suggested the highest population during July to September on wheat and maize, on pulses they found the maximum population during the rainy season in moong. Barhard et.al., 1981 suggested acaricide susceptibility in the lone star Tick : (Assay Techniques and Baseline data).

Koura et. al., 1971, found the preference of cowpea weevil Callosobruchus maculatus F. to some legume seeds and weight loss due to the insect infestation. Sinha and Prasad 1988, observed seasonal variation and peak periods in the population of Callosobruchus chinensis (L.).

Sinha 1993, has estimated the loss to the crops of about 9% in developed countries and 50% in developing nations.

Raju 1984, studied the staggering storage losses its causes and extent.

Venkatrao et. al., 1960, studied the effective infestation on stored field bean and black gram (Phaseolus radiatus).

Atwal 1976 found that Pheromones and hormones inhibit the metabolic activity of the insect. The application of these compound in the larval stage prevent population in the last nymphal instar or in the pre-pupal stage, he suggested that these substances are not structurally related to any vertebrate hormone therefore safe for human being. Various workers have

tried to find plants which could act as anifeedant substance to control insect pest. Adams et. al., 1988, in USA found termiticidal activities in the heartwood, bark/sapwood and leaves of Juniperus species.

Ahmed 1988 studied the potential used of neem tree for pest control and rural development.

Ahmed and Grainge 1986 worked on the potential of neem tree Azadirachta indica for insect control. Bhathal et. al., 1994 observed the insecticidal activity of Ageratum conyzoides Linn. against Lipaphis erysimi katlen bach.

Chada, M.S. 1986, gave the trends in the application of natural products in the plant protection. Deshpande, A.D. 1967, found neem as seed protectant against storage pest. In IARI New Delhi. Deshpande et. al., 1988, presented a paper in the National seminar on integrated pest control of using some plants and their insecticidal properties. Ruscoe 1972, studied the growth disruption effects of an insect antifeedant. Soflla 1993, found the effect the neem (Azadirachta indica, A Juss) on millet head worm (Ragghuvas p.) Dixit and Saxena 1990 have found insecticidal action of Premina integrifolia against Callosobruchus chinensis. Gajendra, G. 1980, studied the antifeedant activity of Parthenium hysterophorus on Spodeptera litura. Gupta et. al., 1994, studied the insecticidal activity of Ageratum conyzoides against Callosobruchus chinensis.

Mukherjee and Chatterjee 1993, found antitumor activity of Parthenium hysterophorus in transplanted murine leukemia. Pandey et. al., 1976, used some plant powder as protectant against Callosobruchus chinensis. Pathak et. al., 1991 found Hepatoprotective activity of Tridex procumbens.

Pradhan et. al., 1962, found neem seed deterrent to locusts and later Pradhan et. al., 1971, gave confirmation for antifeedant properties of neem kernal.

Prakash et. al., 1989 explioted natural plant products against pest and diseases in rice ecosystems. Rao et. al., 1995 worked on the control of root knot nematode on Tomato by neem cake. Roomi and Ariquiddin., 1977, observed the repellent activity of neem plant on some stored grains pests from Pakistan. Suresh et. al.,1994, found bronchial provacation with Parthenium pollen extracts in bronchial asthma. Girish and Jain 1974, studies on efficacy of neem kernal powder against stored grain pests. Jotwani and Sircar 1965, found the neem seed as a protectant against stored grain pests. Meshram et. al., 1997 found antifeedant activity of Lantana camera and Eucalyptus hybrid to the larvae of teak defoliator, Hyblaca pueracram. Newrot and Harmatha 1994, found natural products as antifeedant against stored products insects. Prakash et. al.,1981, studied Begunia leaves as paddy grain protectant. Rao, 1992, found effect of neem Azadirachta indica A. Juss on the mosquito fish, Gambusia affinis. Saxena et. al., 1992 found insecticidal action of Lantana camera against Callosobruchus chinensis. Singh et. al., 1993, found Neem dust for management of stored grain pest. Warthen, 1979, gave a review article on Azadirachta indica a source of insect feeding inhibitors and growth regulators.

During these days great emphasis is laid on the control of the pest and insects rather than their irradicaiton for this, efforts are made to develop repellents, feeding deterrence growth retartdents etc. which are aimed to prevent rather than to kill the insects.

Chemical insects repellents has found great importance in the protection against mosquito, files etc. and also to repell the insects therefore

antifeedant in this connection play an important role as they hinder the feeding of insects. They may serve as feeding detterance. These compounds do not kill the host immediately and thus the predators does not suffer a set back. Some chemical compositions have the same biological activity as the natural juvenile hormone, which are highly active in very small quantities. This penetrate the insects cuticle like natural hormones and thus have great potential in insect control application of these compounds in the larval stage prevent pupation stage and thus become effective in controlling the insects. Since these are not related to verteberates hormones they are safe During the present study emphasis has been laid on the search of natural antifeedant compound which could protect the stored food grains.

The aim was to exploit the toxic properties of some compound found in plants in using them against the pests Various persons have used plant extracts for such purpose. Ascher and Meisner 1989, in this connection have studied the effects of neem extract on insects effecting man and animals. Boby 1996, studied on the biological activity of certain plant extracts of family : Asteraceae on some insect pests. In 1994 studied on repellent and phagodeterrent activity of Sphaeranthus indicus extract against Callosobruchus chinensis. Chauhan and Qadri 1989, studied on antifeedant and insecticidal activity of indigenous plant extracts against Oak borer. Dixit and Saxena 1990, studied the insecticidal action of Premina integrifolia against Calllosobruchus chinensis. They also studied antiovipositional effect of Adhatoda vasica leaf extract against two species of Callosobruchus chinensis. Dixit et. al., 1991, studied the insecticidal activity of neem flower extracts against Callosobruchus chinensis an stored grain pests. Gupta 1996, studied the laboratory evaluation of some plant extracts as protectants against selected stored grain pests. Ladd et. al., 1978, have studied the effects of neem

tree (Azadirachta indica) seeds extract as feeding detterents against Japanese beetles.

Nawrot et. al.,1982, studied the deterrent activity of the compositae plant extracts on selected storage pests. Pandey et. al., 1976, used of some plant extracts to protect pulse beetles Callosobruchus chinensis. Saxena and Saxena 1992, studied the effect of Ageratum conyzoides extract on the developmental stages of malaria vector Anopheles stephensi (Diptera: Culicidre). Schmutterer 1986, studied fecundity reducing and sterilizing effects of neem seed kernel extracts in Colorado Potato Beetle, Leptinotarsa decemlineata. Shrivastava et. al., 1995, studied biological activity of Sphacranhus indicus L. extract against Tribolium castaneum. Singh et. al., 1988, studied the antimicrobial principle from Sphacranthus indicus L. (Family – Compositae). Sinha and Singh 1990, studied the Lethal effect of aqueous extracts of Parthenium hysterophorus on the tadpoles of Rana tigrina. Oda et. al., 1977 studied on insecticidal constituents of Juniperus recurva Buch.

Tunon et. al., 1994, studied on mosquito repelling activity of compounds occuring in Achillae millefolium L. (Asteraceae). Chitra et. al., 1990, have studied effects of certain plant extracts in the control effects of certain plant extracts in the control of Brinjal spotted leaf beetle, Henosepilachna viginctioctoplunctata Fabr. Saraf et. al., year studied Juvenile hormone activity of petroleum –ether extract of Tridex procumbens Linn. Singh and Kataria 1985, studied toxicity of some plants extracts of mosquito larval. Srivastava et. al., 1993, found evolution of formulated neem (Azadirachta indica A. Juss) extract against mango hoppers and mealybug.

Dubey et. al., 1994, have studied control of filaria vector through a new plant extract. Dubey 1995, have studied effect of Catharanthus roseus extract on developmental stages of Earias fabia stall. Mukherjee et. al., 1990, have studied evoluation of neem (Azadirachta indica A. Jurs) products as wheat grain protectants against Sitophilus oryza Linn. Pandey et. al., 1986, have studied effect of some plant extracts on pulse beetle, Callosobruchus chinensis Linn. Rai 1994, studied in-vitro evaluation of aqueous leaf extract of Parthenium hystrophorus Linn. against Rhizophus oryzae, a causal organism of otomycosis in college students.

Raddiffe, et. al., 1991, studied the antifeedant effect of neem, Azadirachta indica A. Jurs, kernel extracts on Kraussania angulifera a sahelian grasshopper in Tropical Agriculture. Rai 1993, made the laboratory evaluation of fungitoxic activity of crude extract of Parthenium hysterophorus. Saxena and Saxena 1989, made the laboratory evaluation of Azadirachta indica flower extract against malaria vector. Sinha and Singh 1990, studied the lethal effect of aqueous extracts of (Parthenium hysterophorus) on the tadpoles of (Rana tigrina). Talakal et. al., 1995, found in-vitro antitry panosomal potential of Xanthium strumarium leaves and Parthenium hysterophorus flowers. Fresh juices and aqueous extracts of (X. strumarium) leaves and (Parthenium hysterophorus) flowers were evaluated for their antitrypanosomal activity in-vitro Juices of both the plant exhibited trypanocidal activity, when used undiluted and in the dilution of 1:2 and 1:20. Velu and Sankaran 1994, studied the effect of Parthenium hysterophorus extract on germination and seedling growth of crops. Zarroug et. al., 1988, have studied the evaluation of Sudanese plant extracts as mosquito larvicides. During which out of the eight plant extracts tested against mosquito larvae, three possessed high larvicidal activity. These were Randia nilotica, Gardenia lutea and Balanites aegyptiaca, four extracts, Croton macrostachys, Azadirachta indica, Arislolochia bracteata

and Dioscorea dumetorum, showed slight larvicidal activity while the remaining one, Vigna fragrans did not possess any larvicidal activity.

Protectant activity of essential oil have also been tested for preservation of Agriculture crops as well as for the use against fungal and bacterial organism. Various workers in this regard have tried to test their antimicorbial and inecticidal capability during the last few decades. Atri and Prasad 1979, studied the pesticidal values of neem oil with reference to future role in Agriculture. Bhattacharya and Bordoloi 1986, studied the insect growth retardant activity of some essential oils. Deshpande and Sharma 1990, worked on the antifeedant action of selected forest seed oil against three lepidopteran pests. Jacob et. al., 1981, studied the effeciveness of several polynsaturated oils on boll weevil feeding deterrents. Naraynan et. al., 1980, found the phagodeterrency of various fractions of neem oil against Schistocerca gregaria forsk. Tandan et. al., 1988, found that neem oil when administered in albino rabbits by intradermal injection produced an increase in the cutaneous capillary permeability. Venugopal Rao et. al., 1993, found that neem oil based formulations could be used as additives to insecticides against Helicoverpa armigera Hub. Ali et. al., 1983, found the effectiveness of some plants oils against pulse beetle, Callosobruchus chinensis Linn. Baitha et. al., 1993, found the effectiveness of neem cake, neem seed kernel extract and neem oil quite effective against rice pests. Chander and Ahmed 1986, studied the efficacy of oils from medicinal plants as protectants of green gram against the pulse beetle Callosobruchus chinensis. Dale and Sarademma, 1981, found the insect antifeedant action of some essential oils. Hinfnawy et. al.,1990, studied the essential oil of Artemisia monosperma and its larvicidal effect. Kachare et. al., 1994, found the efficacy of different vegetable oils as seed treatment in increasing storage ability of pigenpea seed against pulse

beetle. Callosobruchus chinensis L. Naumann and Isman 1995, found the evoluation of neem Azadirachta indica seed extracts and oils as oviposition deterrents of noctuid moths. Pathak and Dixit 1988, studied the insecticidal and insect repellent activity of essential oils of Tridex procumbens and Cyathocline lyrata. Sinha and Mehrotra 1988, have studied difflubenzuron and neem (Azadirachta indica) oil in control of Heliothis armigera infesting chickpea (Cicer areitinum). Srivastava et. al., 1986, found mechanism of inhibition of CMV by Crude Oil from Margosa (Azadirachta indica) during inoculation with single apterous aphis gossypii. Dixit and Sarai 1989, studied the insect repellent and juvenile hormone mimic activity of essential oil of Tridex procumbens Linn.

Active components form plant materials could be isolated through chromatographic procedure these substance has been found in various extracts and oils, their identification and structural ellucidation has been carried out by various persons through NMR, UV spectroscopy and HPLC procedure through, which various persons have made quantitative and qualitative determination. Harborne 1984, have described various phytochemical methods and mordern techniques of plant analysis. Jacobson et. al., 1978 have studied chemistry and biological activity of insect feeding detterents from certain weed and crop plants. Stock and Rice 1978, described chromatographic methods in their book.

Zanno et. al., 1975, studied the structure of the insect phagodeterrent Azardirachtin application of PRET CWD Carbon –13 nuclear magnetic resonance. Chiu and Zhang 1989, determined 2 new diterpenoids structure through chemical and spectroscopic studies. Mahato et. al., 1987, studied of constituent of Azadirachta indica and Melia azadirachta.

Awang et. al., 1991, studied the Parthenolide content of fever few (Tanacetum Parthenium) assessed by HPLC and 1H-NMR spectroscopy Brimely and Barett 1953, gave various methods for practical chromatography in their book published by Chapman and Hall London. Fontanel 1990, studied the HPLC determination of Parthenolide content from Tanacetum Parthenium (L.). Schulz B.P. Plants medicinales et Phytotherapie.

Verma and Gupta 1988, studied the lipid constituents of Tridex procumbens. By such methods various workers have obtained various ingredients from different plant extract and oils. Krishnaswamy and Ramji, 1995, obtained sesquiterpene lactones from Enhydra fluctuans. Olechonowicz – Stepien W. 1963, found the isolation of helenine and main compounds of the Crystaline fraction of the essential oil of the roots of Inula helenium. Ahmed et. al., 1993, obtained new sesquiterpene – methylene lactones from the egyptian plant Jasonia candicans Ara, et. al., 1989-99, found Tricyclic diterpenoids from the stem bark of Azadirachta indica. Ara et. al., in 1990, found new diterpenoids from the stem bark and root of Azadirachta indica. Chiu and Zhang 1989, found 2 New diterpenoids, margosone and margosolone isolated from the stem bark of Azadirachta indica. Deither 1997, found chemical insect attractants and repellents.

In 1989, he studied meliacin cinnamates from the root bark of Azadirachta indica. Dodman et. al., 1992 reported the quantitive method for the estimation of parthenolide and other sesquiterpene lactones containing alphamethylene butyrolactone functions present in fever few Tanacetum parthenium phytochemical analysis. Gadre 1991, studied the toxins and allelochemicals from Lantana camera. Govindachari et. al. 1992, reported two new tetranortriterpenoid. Azadirachtins H and I and the structure of Azadirachtin K, a new tetranortriterpenoid from Azadirachta indica. Kuldeep

et. al., 1991, found parthenin from Parthenium hysterophorus L. an antiauxin. Majumder et. al., 1987, reported nimbidiol a modified diterpenoid of the root bark of Azadirachta indica. Matinez et. al., 1994, found the antimicrobial properties of argentatine A, isolated from Parthenium argentatum. Rojatkar et. al., 1989, described tetranortriterpenoids from Azadirachta indica.

Sankaram et. al., 1993, described the new tetranortriterpenoids from Azadirachta indica. Siddiqui et. al., 1992, found the triterpenoids from the fresh fruit coats of Azadirachta indica. Siddiqui et. al., 1988, described Phenolic tricyclic diterpenoids from the bark of Azadirachta indica. Siddiqui et. al., 1986, found isoazadirolide, a new tetranortriterpenoid from Azadirachta indica. Siddiqui et. al., 1991, described tetracyclic triterpenoids of the fruit coats of Azadirachta indica. In 1991, the terpenoids from fruit coatings of Azadirachta indica. In 1987, isolated the isonimolide and isolimbolide, two new tetranortriterpenoids from the twigs of Azadirachta indica. A. Juss (Meliaceae).

The protectant activity of these isolated principles have been studied by various workers in the field. Butterworth and morgan et. al., 1968, found a substance that suppresses feeding in locusts. Cole et. al. 1990, found a Neoclerodane insect antifeedants from Scutellaria galericulata. Deshpande et. al., 1974, worked on Juvenile hormone like activity of some Indian plants. Dixit and Saraj 1988, found insect repellent and juvenile hormone and mimicing activity of essential oil of Tridex procumbens Linn. Gupta et. al., 1993, found antifeedant activity of cucurbitacins from "Iberis Amara against larvae of Dieris Rapae". Krishnayya and Rao 1996, found a natural bioactive principle against insects. Kawaguchi et. al., 1989, found several antifeedant from Phellodendron amurense against Reticulitermes separatus. Doskotch et. al., 1977, studied Peroxyferalide : a New cytoxic germacranolide from

Liriodendron tulipifera. Garg et. al., 1994, studied neem (Azadirachta indica A. Juss, Meliaceae) from ethnomedicine to modern system of medicine. Gujar 1993 suggested the neem cake and oils to be used as pesticidal for protection of grains during storage. Koul et. al., 1990, described properties and uses of neem Azadirachta indica. Kumkum Rani and Akhila 1994, found biosynthetic relationship between nimocinol and nicocinolide in Azadirachta indica. Mukherjee 1990, studied evaluation of neem (Azadirachta indica A. Juss) products as wheat grain protectants against Sitophilus oryza Linn.

Liu et. al., 1990, found insect antifeedant agents sesquiterpene alkaloids from Celastrus angulatus Mortinez et. al., 1994 studied the antimicrobial properties of argentatine A, isolated from Parthenium argentatum. Prakash and Mathur 1985 found active principle in plant products used in insect pest management of stored grains. Rembold 1994 found Azardirachtin A botanical insect growth inhibitor and its relation to biosemiotics proceedings. Hausen et. al., 1991, studied a New sesquiterpene lactones from Yarrow (Achillea millefolium) L. Saxena 1989, has written a insecticide from neem in the book insecticides of plant origin. Shrivastava and Shrivastava 1996, found the insect antifeedant novel limonoides from the roots of Melia azedarach. Yoshiyasu et. al., 1992, studied the insect growth inhibitory cordenolide glycosides from Anodendron affine Yadava et. al., 1987, made a preliminary study on the pulse by indigenous plant products. Burnett et. al., 1974, found the sesquiterpene lactones insect feeding deterrents in Feronia. Dixit and Sarai 1989, studied the insect repellent and juvenile hormone mimic activity of essential oil of Tridex procumbens. Hosozawa et. al., 1974, found the antifeedant active substance for insect in plant. Joshi 1967, studied on the antifeedant properties of tripenyltin acetate against the tobacco caterpilar Prodenia litura F. Kraus et. al., 1987, worked on tetranortriterpenoid lactams with insect antifeeding activity from Azadirachta

indica A. Juss (meliaceae). Kubo and Nakonishi 1979, found some terpenoid insect antifeedants from tropical in H. Glissbahler (Ed.). Kumkum Rani and Akhila 1994, worked on biosynthetic relationship between nimocinol and nicocinolide in Azadirachta indica. Shrivastava et. al., 1990, worked on toxicity and antifeedant activity of sesquiterpene lactone form encelia against Spodoptera littoralis. Wada and Munakata 1971, described insect feeding inhibitors in plant III. Feeding inhibitory activity of terpenoid in plants.

Williams et. al., 1995, isolated a new lipophilic flavonol called tanetin which could contribute to the anti-inflamatory properties. Balasubramanian et. al., 1993, has isolated a new flavanone from acetonextract of Azadirachta indica. Similarly a group of potent naturally occuring insect antifeedant, 'Phloroglucinol' type furo-cumarins have been reported by Yajma et. al., 1977. Luthria et. al., 1989, have isolated seen cumarins derivatives from Atalantia racemosa against Spodeptera litura. Thus it is clear that both terpenoids and flavonoids serve as antifeedant or antirepellent substances.

The seed surface is generally covered with variety of micro-organism, these organism are responsible to develop the early rhyzosphere microflora. When the seed are shown in suitable condition, the resting mycelium, spore or cells become active and grow according to the nature of substance excreted from the root surface. These surface flora are also responsible for several seed borne diseases. During storage some organism causes considerable damage. Several workers have isolated fungal organism form the seed surface and have studied their seed pathology. Agarwal et. al., 1972, have isolated Cercospora kikuchii from black gram and green gram form Panthnagar, Haware and Nene 1976, isolated Alternaria species on Cicer areitinum seeds in Hyderabad. Joshi and Singh 1969, isolated a gray mold

Botrytis from gram at Panthnagar Mishra et. al., 1975, isolated Colletrotrichum demaitum causing new diseases of gram. Patel et. al., 1949, reported Oidium species Link ex Fr., from many host from Bombay. Rajendra and Pavgi 1967, have found some new from host Pellicularia rolfsii (Sacc.) associated with many disease. Rao 1965, isolated Alternaria tenuis from the seed of Phaseolus radiatus at Bombay. Rangaswami et. al., 1970, isolated Colletotrichum lindemuthianum (Sacc and Magn) Br. and Cav. from the seed of Phaseolus radiatus from South india. Roy 1973 from the same seed isolated Sclerotinia sclerotiorum (Lib.) de Bary from Jorhat Assam. Uppal et. al., 1935, isolated Pellicularia filamentosa from the seed of Phaseolus mungo from Bombay. Upadhyaya R. and Pavgi 1967, isolated Pellicularia rolfsii (Sacc.) from some new host at West (U.P.).

Some workers have used plant material to control various diseases of plant and growth of fungal organism Dohroo and Khan 1993, studied on the potential role of neem in the control of root knot nematodes and ginger rhizome rot. Boulter 1993, found insect pest control by copying nature using genetically engineered crops. Lowery and Isman 1994, studied the insect growth regulating effects of neem and Azardirachtin on aphids.

Polasa and Rukmini 1987 found the used rice bran oil and other vegetable oils for Salmonella typhimurium / microsome system. Steinhauer 1993, found fungicidal activity of some compound from a methanolic extract from Azadirachta indica.

Some workes have even studied the effect of plant products on animals and human diseases. Gromek et. al., 1991 from Poland have made attempts on Chrysanthemum parthenium as prospective antimigraine drug. Kinungo et. al., 1992, have studied the effect of Tridex procumbens on normal

and keparine induced prolongation of clotting time in rabbits. Pathak et. al., 1991, have found Hepatoprotective activity of Tridex procumbens. Saraf et. al., 1992, have also shown hepatoprotectie activity of Tridex procumbens. Saraf et. al. 1991, found hair growth promoting activity of Tridex procumbens. Sharma and Bhutani 1988, found amoebicidal activity of Parthenin isolated from Parthenium hysterophorus. Sharma et. al. 1987, found antiandrogenic properties of neem seed oil (Azadirachta indica) in male rat and rabbit. Singh 1994 demostrated the role of Azadirachta indica (neem) in common skin disorders of man. Subramanian and Lakshmanan 1993, found antileprosy activity of Azadirachta indica stem bark. V. Dupa et. al., 1991, found the influence of Tridex procumbens on lysyl oxidase activity and wound healing. Brown 1993, suggested the production of anti-malarial and anti-migraine drugs in tissue culture of Artemisia annua and Tanacetum parthenium. Deshmuk 1993, studied larvicidal, inseciticidal and insect repellent properties of neem, Azadirachta indica against medically important insects. Matemu and Mosha 1986, studied the toxic effects of neem (Azadirachta indica) berry extract on mosquitoes.

SECTION 3

MATERIALS AND METHODS

MATERIALS AND METHODS

CHAPTER 1

Exercise no. –1

Collection of Plant Materials :

Collection of plants from surrounding areas during different seasons of the year was done from Jhansi District (U.P.). Leaves of different plants were collected, washed thoroughly and then dried at room temperature for more than a month. Air dried plants materials were grinded to powdered form of about 40-60 mesh size, weighed and stored in plastic bottles. After preliminary screening with a number of plants materials, finally 5 species of plants belonging to different families were selected. Three plants belonged to Asteraceae family and one each was from Meliaceae and Verbenaceae family. Namely – Ageratum conyzoides, Tridex procumbens & Parthenium hysterophorus belong to Asteraceae family, Azardirachta indica belong to Meliaceae family while Lantana camera belong to Verbenaceae.

Exercise 2 –

Preparation of Water and Solvent Extracts :-

Exercise 2 (a) :

Extraction of distilled water extract :-

Desired quantity of 40-60 mesh size powdered material of these plants were kept with distilled water in 500 ml. beaker on magnetic stirrer for

30 minutes. Then it was allowed to settle, later filtered through whatman filter paper No. 1 under suction. The clear filtrate so obtained was used as distilled water extract. Experiments were conducted in 1%, 2% and 3% concentration of distilled water extract. To prepare 1% concentration of water extract 1 gm. powdered material was taken in 100 ml. distilled water. Similarly for 2% and 3% concentrations. 2 gm. and 3 gm. powder material was respectively used in different beakers having 100 ml. distilled water.

Exercise 2 (b) :-

Extraction of Cold Solvent Extracts :-

17 gm. of powdered plant materials of selected plants were kept separately in conical flask of 500 ml. capacity on magnetic stirrer for 30 minutes in different solvents separately i.e. Acetone, Petroleum ether and Methanol. The cold percolation extracts were obtained after filteration and evaporation under vaccum at room temperature. The percentage yield of the cold solvent extracts so obtained has been shown in the table 1. The dried cold solvent extracts so obtained were used as and when prepared. For obtaining dilutions Acetone was used.

Exercise 2 (c) –

Extraction of hot solvent extract of plants by soxhlet :-

17 gm. powdered material of selected plants were taken for extraction in the "Soxhlet apparatus". Solvents such as petroleum ether, acetone and methanol were used to prepare solvent extract. After complete exhaustion in the "Soxhlet apparatus" the extract was filtered by Whatman filter paper No. –1 and the solvent was evaporated to dryness under reduced pressure in a vaccum evaporator at room temperature. The amount of extracts

thus obtained was weighed and percentage yield of plant extract in each solvent was calculated and shown in the table II. This dried hot solvent extract thus obtained was then added with traces of toluene to prevent fungal growth and were then kept in glass vials with stoppers in refrigerator for further purification, identification and bioassary experiments.

Exercise 3 –

Extraction of Essential Oil :-

Fresh leaves of selected plants were collected from the surrounding areas of Jhansi district (U.P.) during different seasons of the year. After collection, plant materials were brought to the laboratory & washed thoroughly. Fresh leaves were subjected to stem distillation in the "Perkins apparatus" till clear distillate was obtained. Distillate was then saturated with sodium chloride and extracted with light petroleum ether in separating funnel.Petroleum ether was then removed on water bath at 40 ^{0}C temperature. The yield of essential oils was noted and shown in the table III. The essential oils were kept in vials with stoppers in refrigerator at 4 ^{0}C temperature. The oils were diluted in acetone as and when required for studying the antifeedant activity against Callosobruchus chinensis.

Exercise 4 –

Laboratory culture of Callosobruchus chinensis :-

For the present study the pulse beetles namely Callosobruchus chinensis was selected which generally infest the storage pulse grain namely Phaseolus mungo (mung), Phaseolus radiatus (Urd), Lens esculenta (Lentil or Masur), Cicer areitinum (black chana) and its variety Cicer kabulicum (white gram) etc. in the godowns and other places at Jhansi (U.P.).

Callosobruchus chinensis were collected from infested seeds of the godowns and grain market of the local area during different seasons and months round the year.

For the experimental biossay, red gram, green gram, black gram and other seeds of pulses have been kept for more than 24 hrs. in an oven at 70 ^{0}C so that the infection if any, is removed from the seeds before experiments. The infected seeds of pulses were kept in separate bottles for rearing of Callosobruchus chinensis. For rearing, glass vials were kept inside the insect rearing cabinet present in the laboratory. Cabinet was maintained at 27 $\pm$ 2 ^{0}C and Rh 75 $\pm$ 10 percent with usual 14:10 L.D. photoperiod. After the emergence of the beetles adults were separated and kept in different glass vials for experimental bioassays.

CHAPTER –2

Exercise - 5

Bioassay test –

Preliminary screening of powdered plant material against Callosobruchus chinensis:-

For preliminary screening, plants generally known for antifeedant activity were collected from their natural habitat and brought to the lab. For screening these plant materials were dried in shade and later powdered to 40-60 mesh size for test for there protectant activity as described in exercise 1. For protectant activity 50 gm. seed each of Phaseolus mungo (mung) Phaseolus radiatus (Urd), Lens esculenta (Lentil or masur), Cicer areitinum (Chana black) and its variety Cicer kabulicum (white gram) were

kept in separate jars of 250 ml. capacity. To each jar plant powder of each plant material in the quantity of 4 gm was introduced, the mouth of each jar was covered with a cloth and tied with twin so as to provide aeration 4 insect and at the same time to protect the insect from escaping. Before tieding the mouth 5 healthy insect beetles of Callosobruchus chinensis were introduced. Experiments were run in triplicates. The experimental jars were kept in laboratory cabinet and the protectant activity of the plant powders were recorded after a period of 2 months. The protectant activity was analysed in terms of insect death. Controls were run side by side in which none of the plant powdered materials were added. The data recorded has been show in the Table IV.

Exercise 6 –

Protectant activity of selected powdered plant materials :-

After the preliminary screening, plants showing antifeedant activity were selected for further studies. Among these plants best results were obtained from Ageratum conyzoides, Tridex procumbens, Parthenium hysterophorous, Azadirachta indica and Lantana camera therefore selected for detailed study. These plant's powdered materials were used for protectant activity of Phaseolus mungo, Phaseolus radiatus, Lens esculenta, Cicer areitinum and Cicer kabulicum. 50 gm seeds of each were taken in separate jars of 250 ml. capacity to test the antifeedant activity in 2 gm., 4 gm. and 5 gm. powdered materials of each plant. The mouth of jars were tied with a cloth after introducing 5 healthy insects beetles of Callosobruchus chinensis. Experiments were run in triplicates and the protectant activity of the powdered materials were recorded after 4,8 and 12 months interval. The protectant activity was analysed in terms of the cereals % protection & mortality percentage. Controls were run side by side in which no powdered materials

were added. The protection percentage and percentage mortality was calculated according to the following formula :-

(a) Protection percentage = $\frac{\text{Weight of cereals after experiments}}{\text{Initial weight of cereals}} \times 100$

(b) Mortality percentage = $\frac{\text{No. of insect dead}}{\text{No. of insect Inserted}} \times 100$

Recorded were maintained and given in the Table V to XIV.

Exercise 7 –

Protectant activity from composite samples of selected plants powders :-

In this experiment composite sample of the powdered materials were made in which 1 gm plant powder of each plant was mixed, so that total weight of the powdered material to be introduced in to the jar remain 5 gm. Protectant activity of this composite plant powder was then analysed for each cereal's variety against Callosobruchus chinensis. Observations were recorded for percentage protection and percentage mortality after a periods of 10 days and 1 month. The procedure adopted was the same as described in the exercise No. 7. The datas recorded has been shown in the table XV & table XVI.

Another similar experiment on composite powdered plant material was conducted. In which the 3 most active powders were taken instead of 5, the selection of the powdered plants material was based on the basis of the results derived from exercise No. 6. In this experiment each jar was interduced with 1.66 gm plant powders of Azadirachta indica, Lantana camera and Parthenium hysterophorus so that the total powdered material to

be interoduced remain 5 gm. Antifeedant activity of this composite sample was also analysis interms of percentage protection and percentage mortality. The procedure followed was the same as described above. The observation were recorded after 10 days. The datas recorded has been shown in the Table XVII.

Exercise 8 –

Protectant activity of selected plant's distilled water extracts :-

In this experiment 10 gm seeds of each variety of cereals i.e. white gram, black gram, urd, mung and masur were taken separately in sterilised 250 ml. jar. Each jar was treated with.4 ml of distilled water extracts of each plant obtained as described in exercise No. 2(a). Separate jars were used for 1%, 2% and 3% plant extracts respectively. Controls were run side by side in which.4 ml distilled water was added to it in place of plant extracts. 10 freshly emerged beetles of Callosobruchus chinensis from laboratory maintained culture were released in each jar. The mouth of each jar was tied with a piece of muslin cloth to allow gaseous exchange and to prevent the escape of beetles.Observations for the protectant activity of 1%, 2% and 3% distilled water extracts were made after 10 days and the percentage mortality was calculated after 4, 7 and 10 days. In this experiment the weight of the 10 gm. seeds increased with the addition of distilled water extracts and there fore the weight of the cereals after addition of the extracts were considered while calculating the percentage protection. The percentage protection was calculated with the following formula –

$$= \frac{\text{Weight of the cereals after 10 days}}{\text{Weight of the cereals after addition of distilled water extracts.}} \times 100$$

Records were maintained and given in the Table XVIII to XXVII. The experiments were run in triplicates and carried out under controlled temperature and humidity.

Exercise 9 –

Protectant activity of selected plant's cold solvent extracts :-

Cold solvent extracts of the selected plant materials were obtained as described in exercise 2(b). For this experiment 10 gm seeds of each cereal variety were taken in sterilized in 250 ml. jar, then seeds were treated with.4 ml. of 1%, 0.5% and 0.25% of the cold solvent extracts. 10 freshly emerged beetles of Callosbruchus chinensis from laboratory maintained culture were released in each jar. The mouth of the jars were tied with muslin cloth to prevent escape of beetles and provide gaseous exchange. Controls were run side by side using Acetone in place of cold solvent extract. For preparation of dilution Acetone was used. Experiments were run in triplicates under controlled temperature and humidity. Observations were recorded interms of precentage protection and percentage mortality on 4,7 and 16 days interval. The data's obtained have been shown in the Table XXVIII to XXXVII.

Exercise 10 –

Protectant activity of selected plants hot solvent extracts :-

In this experiment solvent extracts of plants obtained through "Soxhlet apparatus", as described in exercise 2(c), were used and called hot solvent extracts. These extracts has been used in 1%, 0.5% and 0.25% concentrations. Acetone was used to dilute the hot solvent extracts. Separate tests were made for different concentrations of plant extracts obtained through

petroleum ether, methanol and acetone solvents. 10 gm seeds of each cereals were taken in separate 250 ml presterilised jars, each such jar was taken for 1%, 0.5% and 0.25% concentrations and for 4,8,12 and 16 days. As such for each antifeedant plant and 3 solvents a set of 36 jars were taken to test one cereal. Experiments were run in triplicates. All the jars of each set were treated separately with.4 ml. of the above desired dilution of hot solvent extract. 10 freshly beetles emerged bettles of Callosobruchus chinensis from laboratory maintained culture were released in each jar. Controls were run side by side using acetone in place of hot solvent extract. The mouth of each jar was tied up with a piece of cloth for obvious reasons and the jars were kept for observation under controlled temperature and humidity. Observations were made after 4,8,12 and 16 days interms of percentage protection and percentage mortality. Datas as obtained have been shown in the Table XXXVIII to XXXXVII.

Exercise 11 –

Protectant activity of selected plants essential oils :-

The essential oils of selected plants obtained through "Perkins apparatus" as described in exercise 3 was used for the above test. 10 gm seeds of each variety that is mung, urd, white gram, black gram and masur were taken separately in presterilised 250 ml. jars. The seeds of each jar were treated with.9 ml of 1%, 0.5% and 0.25% essential oil. Dilutions were prepared using acetone solvent. Separate sex of jars were prepared for each essential oil obtained from selected antifeedant plant. Experiments were run in triplicates. 10 freshly emerged adults beetles of Callosobruchus chinensis from laboratory maintained culture were released in each jar. Controls were run side by side using acetone solvent instead of essential oil. Mouth of each jar was tied with a piece of cloth to prevent escape of beetles and provide

gaseous exchange. The jars were kept for observation under controlled temperature and humidity. Observations were recorded after 5,10,15 and 20 days. The observations were made in terms of percentage protection activity and percentage mortality. Datas as obtained haven been shown in the Table XXXXVIII to XXXXIX.

CHAPTER 3

Phytochemical Studies

Exercise 12 –

Purification and Isolation of active Principle :-

The extracts obtained in petroleum ether, acetone and methanol from the plants were purified by chromatographic methods. Both thin layer and paper chromatographic technique were used the various fraction obtained were collected in glass vials and dissolved separately in solvent for further isolation and structural elucidation.

Exercise 12(a) –

Paper Chromatography :-

The active principles present in solvent extracts obtained through different solvents were separated using solvent mixture n – butanol : acetic acid : water (4:1:5), which is abbreviated as BAW were assessed on PPC paper. A little amount (.4 mg) of solvent extracts were dissolved in.25 ml of dichloromethane (Methylene dichloride) and were applied with the help of capillary tube as a minute spot at a distance of 3 cm. From one end of a chromatographic paper. The spots were then dried and concentrated with hot air blower. The spotted paper was then hung in the previously saturated

descending paper chromatographic chamber having solvent mixture poured in the cylindrical trough mounted near the top of the chamber. The spotted end of the chromatographic paper was immersed into the solvent mixture contained in a narrow trough mounted near the top of the chamber taking care that the marked spots remained well above the level of the solvent in the trough. The chromatographic paper is suspended in such a manner so that it hangs freely without touching the sides of the chamber. In this case the solvent desends in to the paper. When the solvent has run to the desired distance the paper was taken out and air dried after marking the distance to which the solvent has run. In most cases, the completed chromatograms were colourless with no indication of the presence of any compounds. For locating the various compounds, the chromatographic paper was first dried in air then sprayed with Ammonia vapours. The reaction occurs and the coloured spots appears of the various ingradients. The distance travelled by the solvent and the solutes were then measured by a centimeter scale to calculate the Rf value.

$$Rf = \frac{\text{Distance between origin and centre the spot}}{\text{Distance between origin and solvent front}}$$

Exercise 12 (b) - Thin Layer Chromatography :-

The crude extracts obtained through different solvent were assessed on TLC plates to find out the active principles present in them. For the same, the glass plates (20 x 5 cm) were cleaned thoroughly with detergent and water, drained and dried in the oven at 60 ^{0}C. Touching the surface of the cleaned plates with fingers was avoided. These dried plates were kept on a commercially obtained moving spreader frame. Later the absorbent silica gel of 40 – 60 mesh size was made in to a slurry with water, usually in the proportion 20 gm. of silica gel and 2 x 20 cm^3 of water. The slurry was thoroughly stirred and powered on to the rectangular hopper, which was kept on the TLC plates and then passed over the plates. The hopper had no bottom

and its trailing face had an adjustable lower edge to give an even layer of 0.50 mm thickness. After spreading the slurry uniformly the plates were allowed to dry for 30 – 40 minutes and activated by heating at about 70 ^{0}C for 1 hour in the oven. A little amount of solvent extracts were dissolved in dichloromethane (Methylene dichoride) and were applied with the help of a capillary tube as a minute spot at one end of the plate i.e. 1 cm. above from the lower edge of the plate. The spots were allowed to dry & concentrated with 2 to 3 application and the plates were then kept carefully in glass container containing the solvent system. After the run of the solvent on the plates upto marked line they were taken out from the container. The runoff of the solvent and substance was marked and measured with a centimeter scale to determine the Rf value as defined by Brimely and Barrett (1953).

$$Rf = \frac{\text{Distance moved by substance}}{\text{Distance moved by solvent front}}$$

Exercise 13 –

Structural elucidation of biological active compounds :-

The chromatographic fractions which showed antifeedant activity in exercise 13 were used to determine the structure of the compound through UV spectrum and confirmed with the not standard compound.

Exercise 14 –

Protectant activity of isolated principles :-

The active principle isolated through paper and thin layer chromatography were used to study the protectant activity. The spots developed on paper chromatography and thin layer chromatography were

taken out and dissolved in spectroscopic methanol. Dissolved fraction was separated through centrifuge at 4000 rpm. The suprenatant thus obtained was used to test the antifeedant activity with out any dilution. For antifeedant test 10 gms. seeds of each cereals were taken in presterilised jars. These were treated with.4 ml of the active fraction obtained as above. Separate jars were used for each fraction obtained from different selected plants. 10 freshly emerged beetles of Callosobruchus chinensis were introduced in each jar. The mouth of the jars were tied with a piece of cloth. Controls were run side by side using plane chromatographic solvents. This fraction which had shown promising results have been used for structure elucidation. Observations for percentage protectant activity were done after 10 days. Datas as obtained have been shown in the Table L to LIV.

CHAPTER 4

Mycological Studies

Exercise 15 –

Isolation and identification of surface fungal flora from seeds of selected cereals :-

In this experiment fungal flora of each cereal was explored separately. 15 gm. seeds of each cereals were taken in 250 ml round bottom flask having 100 ml sterilised water. These were shaken by wrist action shaker for ½ an hour. The suspension so obtained was used for isolation of the fungal flora. After 10 washings with sterilised water the seeds were seperately placed on the surface of previously poured and solidified agar petri discs. Medium used for isolation was peptone dextrose rosebengal agar with streptomycin.

After isolation of the fungus potato dextrose agar was used for the transfers, identifications and storage of fungal organisms.

Media Preparation :-

(i) *Peptone Dextrose Agar Medium :-* Following ingredients were used –

Agar	-	20 gm
KH_2PO_4	-	1 gm.
$MgSO_4.7H_2O$	-	0.5 gm.
Peptone	-	5 gm.
Dextrose	-	10 gm.
Distilled water	-	1000 ml.

These ingredients were mixed in 500 ml distilled water and heated for30 minutes. When all ingredients have been dissolved the final volume was raised to 1000 ml. and a pinch of rosebengal was added. The medium was then disposed off in to 250 ml. flasks in such a manner that they remain half filled. The flasks were then plugged with cotton and autoclaved at 15 lb pressure for 15 minutes. Before plating streptomycin was added to inhibit the bacterial growth.

(ii) *Potato Dextrose Agar :-* Following ingredients were used –

Peeled and chopped potato	-	200 gm
Dextrose	-	20 gm.
Agar	-	17 gm.
Distilled water	-	1000 ml

Peeled chopped potato were boiled in 500 ml distilled water for 30 minutes and then the extract was decanted in another flask. To this extract dextrose and agar were added and kept on heat till the agar dissolved. The

volume was then raised to 1000 ml by adding distilled water. After mixing the media it was dispensed in 250 ml flask in such a manner that they remain half filled. The flasks were plugged with cotton & sterilised at 15 lb pressure for 15 minutes. Identifications of the fungus were made through standard monographs and live specimens available in the department.

Exercise 16 –

Test for antifungal activity of plant water extract :-

For this experiment antifungal activity of Tridex procumbens, Parthenium hysterophorus, Ageratum conyzoides, Azadirachta indica and Lantana camera water extracts were used for the study of their inhibitory effect on the radial growth of 18 fungal organisms that were isolated from the surface of cereals under study.

The plant extracts were prepared in water as described in exercise 2(a) this extract was then mixed with the ingredients of peptone dextrose agar medium and sterilized at 15 lb pressure for 15 minutes. Separate mediums were prepared with different plant extracts. These mediums where then poured in sterilised petridisc and allowed to solidify. The dishes were then inoculated with 0.7 mm agar disc of test fungi in the centre. Control petridishes were kept without any addition of plant water extract. Triplicates were taken for each plant water extract, for all the 18 test fungi. The disc were incubated at 28 ^{0}C. The diameter of the growing colony was measured after every 24 hours upto 120 hours and plotted against the time taking in both cases with and without adding plant water extract. Histograms of average growth per day of the selected organism were also made.

SECTION 4

OBSERVATIONS RESULTS AND CONCLUSIONS

OBSERVATIONS RESULTS AND CONCLUSIONS

During the study period on screening of plant materials for antifeedant and antifungal activity during storage of cereals, experiment have been conducted on various aspects covering the selection of antifeedant plants, isolation of active principles in water and solvents and finally leading to the separation, purification and structural elucidation of biologically active compounds. At the same time attempts have been made to isolated the surface mycoflora of the seeds which caused damage to the seeds during storage. The plants showing antifeedant activity were also screened to test their antifungal activity on the seed-flora. In the above context observation recorded and the results obtained are being concluded experiment wise in the following text.

CHAPTER 1

EXPERIMENT 1 –

Collection Of Plant Materials :-

During storage of pulses in general various chemicals and insecticidal tablets are used to protect the cereals from Callosobruchus chinensis. These substances disturb the ecosystem and at the same time cause biomagnification because of their non biodegradable nature. In order to get an alternative antifeedant substance, which could be ecofriendly, biodegradable and easily available, attempts have been made to get some plant materials which could serve the purpose and at the same time could protect the cereals from fungal losses. With this approach plants easily available and in bulks were collected during different seasons of the year. These plant materials were

tested in the proceeding experiments for antifeedant activity. The plant materials were air dried and then grinded to powdered form, for further test. Initially 20 different species of Angiospermic plants were collected and properly identified through well known monographs and specimens present in the Botany Department herbaria of B.B. College Jhansi (U.P.). Drying was conducted under shade at room temperature so that the antifeedant compound may remain with in the plant. The powdered materials used were of between 40-60 mesh size and stored in plastic bottles in a clean dry place of the lab with every precaution so that the component of the plant material may not be lost. The powdered materials so obtained were directly tested for their antifeedant activity against Callosobruchus chinensis during the preliminary screening studies. This was done with a view to get plants which could serve the purpose of protection and could be used in the easiest way. In the IInd and IIIrd exercise extracts of selected plants were obtained in water and some well known solvents. Essential oils of selected plant were obtained in the IIIrd exercise which were later tested for its antifeedant activity. Studies were centered towards the protection of Phaseolus mungo, Phaseolus radiatus, Lens esculenta, Cicer areitinum and Cicer kabulicum cereals.

EXPERIMENT 2 –

Preparation Of Water And Solvent Extracts :

For obtaining water extracts powdered materials were used and extracts were obtained in distilled water. Magnetic stirrer was used so that proper mixing of the plant materials could be made without any distortion or rise of temperature. These extracts were prepared and used fresh, their colour varied from light green to grey after filtration through whatman filter paper. For obtaining solvent extracts acetone, petroleum ether and methanol were used. Both cold solvent extracts as well as hot solvent extracts were prepared

and in the later experiments tested for antifeedant activity. Cold solvent extracts were prepared on magnetic stirrer from the powdered materials. So that the essentials component remain with in the extracts and there nature may not be altered. Hot solvent extracts were prepared in the soxhlet apparatus. In which separation was conducted till complete exhaustion. After obtaining both cold and hot solvent extracts, solvents were evaporated under reduced pressure in a vaccum evaporator. The percentage yield obtained has been shown in the Table I for cold solvent extracts and Table II for the hot solvent extracts.

Data obtained for percentage yield of cold solvent extracts. Show that Tridex procumbens gave better yield in methanol extracts as compared to acetone and petroleum ether. Similar results have been found for Ageratum conyzoides. Parthenium hysterophorus gave better yield in methanol followed by acetone and petroleum ether. Lantana camera gave better yield in acetone followed by petroleum ether and methanol. Azadirachta indica also gave slightly better yield in acetone followed by petroleum ether and methanol. In general yield was better in methanol solvent for Tridex procumbens, Ageratum conyzoides and Parthenium hysterophorus while Lantana camera and Azardirachta indica gave better yield in acetone. It appears that plants related to composite gave better yield in methanol.

From the datas obtained for percentage yield of hot solvent extracts almost identical yields were obtained as were found in cold solvents. As far as the total yield is concerned percentage yields were better in hot solvent as compared to cold solvents. Again methanol extracts were found to be giving better yield of Tridex procumbens, Ageratum conyzoides and Parthenium hysterophorus. While acetone gave better yields of Lantana camera & Azadirachta indica. It appears that hot solvent mixed up the

TABLE No. –I

Percentage yield of cold solvent extract

S.No.	Name of the Plant	Solved used	Percentage yield
1.	Tridex procumbens	Petroleum ether	1.88235
		Acetone	4.47058
		Methanol	5.7647
2.	Ageratum conyzoides	Petroleum ether	7.47058
		Acetone	12.47058
		Methanol	13.58823
3.	Parthenium hysterophorus	Petroleum ether	7.05882
		Acetone	2.11764
		Methanol	10.58823
4.	Lantana camera	Petroleum ether	2.64705
		Acetone	4.82352
		Methanol	1.58823
5.	Azadirachta indica	Petroleum ether	4.17647
		Acetone	4.70588
		Methanol	3.70588

TABLE NO. – II

Percentage yield of hot solvent extract

S.No.	Name of the Plant	Solvent used	Percentage yield
1.	Tridex procumbens	Petroleum ether	2.235
		Acetone	5.117
		Methanol	6.882
2.	Ageratum conyzoides	Petroleum ether	13.294
		Acetone	17.176
		Methanol	18.529
3.	Parthenium hysterophorus	Petroleum ether	10.411
		Acetone	6.235
		Methanol	11.823
4.	Lantana camera	Petroleum ether	3.705
		Acetone	6.588
		Methanol	2.235
5.	Azadirachta indica	Petroleum ether	5.117
		Acetone	5.176
		Methanol	4.470

component of the powdered material much better than the cold solvents. The behaviour of the plants towards the hot and cold nature of the solvents provide evidences for their relative solubility in different solvents.

EXPERIMENT 3 –

Extraction Of Essential Oils :

For obtaining essential oils fresh leaves and shoot portions of selected plants were used for obtaining essential oils in Perkins appratus. The extraction was made till clear distillates were obtained. After saturating with sodium chloride, extraction was done using petroleum ether in the separating funnel. Petroleum ether was then evaporated on water bath at 40 ^{0}C temperature. The yield of essential oils so obtained has been shown in the table III. The datas obtained clearly show that Azadirachta indica gave the best yield followed by Ageratum conyzoides, Tridex procumbens and Lantana camera. No oil could be obtained from Parthenium hysterophorus. These observations show that the oil content were present in 4 antifeedant plants & absent in one plant.

EXPERIMENT 4 –

Laboratory Cultures Of Callosobruchus chinensis :

Cereals of Phaseolus mungo, Phaseolus radiatus, Lens esculenta, Cicer areitinum and Cicer kabulicum infested with Callosobruchus chinensis were collected form the godowns and local market. These were brought to the lab for rearing the culture of Callosobruchus chinensis. Healthy seeds of the above cereals were brought and kept in oven at 70 ^{0}C for more than 24 hours to remove any infection or infestation. For rearing, the above seeds were kept

TABLE NO.-III

Percentage yield of essential oil

S. No.	Name of Plant	Percentage Yield
1	Ageratum conyzoides	1.25
2.	Tridex procumbens	.92
3.	Azadirachta indica	2.15
4.	Lantana camera	.75
5.	Parthenium hysterophorus	00

in glass vials and healthy insects of Callosobruchus chinensis were introduced in each vials after which cloth was tied at the mouth so that the beetles could not escape and gaseous exchange could take place. These glass vials were kept in insect rearing laboratory cabinet maintained at 27 ± 2 ^{0}C with the relative humidity 75 ± 10% with usual 14:10 L.D. photoperiod. It was observed that the population increased much during August and September and moderately in November, December while least during the summer season under natural environment. This investigation indicate the effect of seasonal variation on the population behaviour of Callosobruchus chinensis. It appears that humidity and temperature are the determining factor for their population variation during different seasons.

CHAPTER 2

Bioassay Test

EXPERIMENT 5 –

Preliminary Screening From Various Plant Powdered Materials Against Callosobruchus chinensis :

Under this experiment powdered materials of 20 angiospermic plants were screened for antifeedant activity against Callosobruchus chinensis useing Phaseolus mungo, Cicer kabulicum, Phaseolus radiatus, Lens esculenta and Cicer areitinum cereals. The protectant activity were analysed after a period of 2 months in terms of percentage mortality of insects. The datas obtained has been shown in the table IV. The datas obtained clearly show that out of these 20 plants some plants could not protect the growth of insects and the damage to cereals. Some plants do gave some protectant activity for some

TABLE NO. –IV

Preliminary Screening for antifeedant activity against Callosobruchus chinensis.

Name of the Plant Powder Used	Family	Percentage mortality after 2 months				
		1	2	3	4	5
1. Adhatoda vasica	Acantheceae	0	0	0	0	0
2. Ageratum conyzoides	Asteraceae	5000	500	80	240	2280
3. Azadirachta indica	Meliaceae	4600	60	60	60	520
4. Annona squamosa	Annonaceae	0	20	0	0	0
5. Clerodendron species	Verbenaceae	0	20	0	20	0
6. Duranta repens	Verbenaceae	20	0	0	20	20
7. Lantana camera	Verbenaceae	5200	1000	3000	60	60
8. Parthenium hysterophorus	Asteraceae	2100	60	2800	100	80
9. Tridex procumbens	Asteraceae	820	500	5000	80	400
10. Argemone mexicana	Papaveraceae	0	20	0	0	20
11. Malvastrum tricuspidatum	Malvaceae	20	20	0	20	0
12. Cassia tora	Caesalpiniaceae	0	20	20	40	20
13. Acacia arabica	Mimosaceae	0	40	20	0	20
14. Zizyphus jujuba	Rhamnaceae	0	0	0	20	0
15. Jatropha gossypifolia	Euphorbiaceae	0	0	0	0	0
16. Achyranthes aspera	Amarantaceae	0	0	0	20	0
17. Ipomoea fistulosa	Convolvulaceae	20	0	20	0	0
18. Lawsonia alba	Lythraceae	20	60	40	20	40
19. Cynodon dactylon	Gramineae	0	0	0	0	0
20. Xanthium strumarium	Asteraceae	0	0	0	0	0

1. Phaseolus mungo 2. Cicer kabulicum 3. Phaseolus radiatus

4. Lens esculenta 5. Cicer areitinum All in 50 gm. weight.

cereals seeds. The best protectant activity were given by 5 angiospermic plants – i.e. Ageratum conyzoides, Azadirachta indica, Lantana camera, Parthenium hysterophorus and Tridex procumbens. These were selected for further detail study. Lowsonia alba also gave some protectant activity for all the cereals used but the percentage mortality was very less as compared to the selected plants.

EXPERIMENT 6 –

Protectant Activity Of Selected Plant Powdered Materials :

From the preliminary screening 5 plants which gave active response on mortality percentage of Callosobruchus chinensis were selected to study their effect on the protectant activity of Phaseolus mugo, Cicer kabulicum, Phaseolus radiatus, Lens esculenta and cicer areitinum. Since a good mortality rate was observed after 2 months it was thought to observe its effect after 4,8 and 12 months durations so that there possible use for a long period of storage could be explored. The datas recorded for percentage protection and percentage mortality has been shown in the tables V to XIV. 50 gms of each cereals were treated separately with 2,4 and 5 gms powdered materials of each plant. Datas recorded has been separately shown for each plant material on percentage seed protection and percentage mortality. Powdered material of Azadirachta indica gave good protectant activity when used in the quantity of 5 gms, however the percentage protection slightly decreased up to 12 months duration. Cicer kabulicum, Phaseolus radiatus and Lens esculenta were 100 percent protected up to 8 months and 99.9 percent after 12 months. Phaseolus mungo, Cicer areitinum were 80.4 and 84.2 percent protected after 8 months, while after 12 months the percentage protection decreased to 80 percent and 78 percent respectively. All these datas are of powdered materials when used in 5 gms quantity. Table VI show the

percentage protection from Lantana camera on treated cereals. This powdered material was good in protecting the seed of Phaseolus mungo and Cicer areitinum like Azadirachta indica. Percentage protection was better when powdered material were used in 5 gm quantity. In this amount Phaseolus mungo and Cicer areitinum were 100 percent protected up to 8 month. Its percentage protection decreased to 95.79 and 99.97 respectively after 12 months duration. The third best percentage protection was of Lens esculenta followed by Cicer kabulicum and Phaseolus radiatus.

Table VII show the data of percentage protection obtained when Parthenium hysterophorus plant's powdered material was used. Like the powder of the above 2 plants, percentage protection gradually increased with the increase in amount of powdered material. 5 gms powder gave the best results. This plant powder gave 100 percent protection to Cicer kabulicum, Lens esculenta and Cicer areitinum up to 8 months the percentage protection after 12 months were in the range of 99.55 to 99.96. Next to these percentage protection rates were followed by Phaseolus mungo and Phaseolus radiatus.

Table VIII has the data on percentage protection when powder of Tridex procumbens plants was used. The results obtained show best protectant activity for Phaseolus radiatus followed by Cicer kabulicum, Lens esculenta, Phaseolus mungo and Cicer areitinum. The protectant ability of 5 gms powder was better as compare to the amounts used in 2 and 4 gms quantity. Phaseolus radiatus was 100 percent protected up to 8 months there 97.9 percent there after 12 months.

Table IX show the datas recorded on percentage protection of cereals with the powdered materials of Ageratum conyzoides. Best results were on Lens esculenta followed by Cicer areitinum, Phaseolus mungo, Cicer

kabulicum and Phaseolus radiatus. Lens esculenta was 100 percent protected in 5 gms powder up to 8 months, while percentage protection was 99.9 after 12 months. From above results it appears that the protectant activity of the plant powders varied from one cereals to the other. However every powdered material gave better results when used in 5 gms quantity as compared to 4 or 2 gms quantity. In 5 gms quantity 100 percent protection was observed up to 8 months for Cicer kabulicum, Phaseolus radiatus and Lens esculenta by the Azadirachta indica., Phaseolus mungo and Cicer areitinum by Lantana camera., Cicer kabulicum, Lens esculenta, Cicer areitinum by Parthenium hysterophous., Phaseolus radiatus by Tridex procumbens and Lens esculenta by Ageratum conyzoides. Even after 12 months the percentage protection was decreased to less than.1 percent in each of these powdered materials.

Table X to XIV show the datas recorded on percentage mortality rate. The increasing rate is due to the fact that the population of the beetles of Callosobruchus chinensis had increased after 4,8 and 12 months durations. It appears that the protectant powdered make the seeds unedible to the beetles and at the same time the powders might be enough insecticidal to kill all the beetles produced or the beetles might have scumbed due to starvation. Datas obtained clearly indicated that the percentage mortality has increased with increase in the quantity of powdered materials used. Datas obtained in these tables show that the powdered plant materials which gave good protection to the cereals seeds have less mortality rates. Where as those which have less protection for the seed gave high mortality rates, the reasons behind this may be that the less effective powdered materials allowed them to reproduce and thus the progeny developed later died and therefor their percentage mortality showed an increased trend. It appears that these powders were though less effective on their reproductive stages but the adults were unable to survive

due to starvation as the seeds were nonedible or the beetles might not be able to consume the seeds.

EXPERIMENT – 7

Protectant Activity From Composite Samples Of Selected Plants Powders :

In this experiment datas have been recorded when all the 5 plant powders were mixed in equal quantity to form composite samples. The datas recorded for percentage protection and percentage mortality have been shown in the tables XV and XVI respectively, these datas have been recorded after 10 days and 1 months durations. The datas clearly indicated that the composite sample of the powdered materials gave 100 percent protection up to 1 month for Cicer kabulicum, Phaseolus mungo and Phaseolus radiatus but in Lens esculenta and Cicer areitinum the percentage protection was though 100 percent upto 10 days but after 1 month it was reduced to 99.9% in Lens esculenta 99% for Cicer areitinum. Percentage mortality as recorded in the table XVI indicate 100 percent mortality during the observations made after 10 days and 1 month duration for Cicer kabulicum, Phaseolus mungo and Phaseolus radiatus. In Lens esculenta, Cicer areitinum the percentage mortality was 80 percent after10 days and 100 percent after 1 month duration.

In order to get better protection and percentage mortality for all the 5 cereals composite sample were made form the plant powders of the most active antifeedant plants. As can be observed from the data obtained in the table V, VI and VII Azadirachta indica, Lantana camera and Parthenium hysterophorus plant powders gave better protectant activity. Therefore compositu samples of only these 3 plant were made to observe their protectant

capability in composite sample. The datas obtained from the experiments in which this composite sample has been used are given in the table XVII. As is evident from the datas obtained that there was 100 percent mortality and 100 percent protectant activity after 10 days. It is clear from the above records that this composite sample could be very well used for storage purpose of the cereals.

EXPERIMENT 8 –

Protectant Activity Of Selected Plants Distilled Water Extracts :

In this experiment distilled water extracts of the selected plants were taken in 1%, 2% and 3% concentrations and the datas obtained after 10 days on the percentage protection and the percentage mortality has been given in the tables XVIII to XXVII. Tables XVIII and XIX show the datas obtained on percentage protection and percentage mortality respectively when distilled water extracts of Azadirachta indica were used. The datas obtained clearly show that the results were better when the distilled water extracts were used in 3 percent concentrations. In distilled water extracts Lens esculenta, Cicer areitinum were best protected and the mortality rates were also 100 percent. The protectant activity gradually decreased in Phaseolus mungo, Cicer kabulicum, Phaseolus radiatus.

Table XX and XXI show the percentage protection and the percentage mortality against Callosobruchus chinensis when distilled water extracts of Parthenium hysterophorus were used. The protectant activity was best observed for Cicer kabulicum, Lens esculenta and Cicer areitinum in 3 percent concentrations of the extracts. The percentage mortality was 100 percent in Cicer kabulicum, Cicer areitinum followed by Lens esculenta, Phaseolus radiatus and Phaseolus mungo in which the percentage mortality

was 90 percent 80 percent and 80 percent respectively after 10 days in 3 percent concentrations of the extracts. When seeds treated with distilled water extracts of Ageratum conyzoides the percentage mortality and percentage protection has been shown in tables XXII and XXIII. The percentage mortality and the percentage protection was best in the seeds of Lens esculenta in 3 percent concentration of the extract. Where the percentage mortality was 100 percent while percentage protection was 99.27 percent.

The results obtained for distilled water extract of Tridex procumbens has been shown in the tables XXIV and XXV. The results obtained for percentage protection has been shown in the table XXIV. In which the best activity in 3 percent concentrations have been shown for Phaseolus mungo and Lens esculenta however percentage mortality was best for Phaseolus radiatus and Cicer areitinum. The percentage protection of Phaseolus radiatus is not very less than these two cereals. There is all most negligible reduction of.1 percent which is quite immaterial.

Tables XXVI and XXVIII show the percentage protection and percentage mortality against Callosobruchus chinensis when the cereals were treated with the distilled water extracts of Lantana camera. These tables show that there was 100% mortality in 3 percent concentrations on the 10^{th} day in case of Phaseolus mungo and Cicer areitinum. These results are inconformity with the results of percentage protection as in 3 percent concentrations there was highest percentage protection of the above cereals. The percentage protection as show in the table is 99.18 of Phaseolus mungo and 99.28 for Cicer areitinum.

In general the results as shown in the table of percentage mortality and percentage protection are all most inconformity and in general

similar to those observed, when powdered materials were used. The antifeedant plants which show good activity in powdered form gave similar performance when used in the from of distilled water extracts. It is quite clear that their active principle is passed in to the water suspension when water extracts was prepared.

EXPERIMENT 9 –

Protectant Activity Of Selected Plants Cold Solvent Extracts :

In this experiment seeds of the 5 selected cereals were treated with the cold solvent extracts obtained in acetone, petroleum ether and methanol solvents. The extracts of different antifeedant plants were used in 1 percent,.5 percent and 0.25 percent concentrations. The datas obtained for percentage mortality and percentage protection has been given in tables XXVIII to XXXVII after 4,8,12 and 16 days.

Azadirachta indica cold extract :-

Tables XXVIII and XXIX give the data obtained for percentage protection and percentage mortality when Azadirachta indica cold extracts were used in acetone, petroleum ether and methanol solvents. The results obtained were better with the increase in concentration of he cold extracts. In 1 percent concentration of the cold extracts the seeds show 100 percent protection upto 16 days, for all the cereals with all the solvent extracts. Even in.5 and.25 percent concentration nearly 100 percent protection was noted upto 12 days. After 16 days negligible decline was noted. The percentage mortality was 100 percent in1 percent concentration for all the days of observations, for all cereals in all the solvent extracts. In.5 percent concentration acetone extracts gave 100 percent mortality in Cicer kabulicum,

Phaseolus radiatus & Lens esculenta against callosobruchus chinensis. In.25 percent concentration again better results were obtained in cold solvents of acetone extracts. It appear that this extract has all ingredients responsible for producing antifeedant activity as compared to other solvent of Azadirachta indica.

Partherium hysterophorus cold extract :-

The protectant activity and its effects on percentage mortality has been shown through datas in the tables XXX and XXXI. These tables show that Parthenium hysterophorus cold extracts were good protectants for all the cereals used in 1% concentration where almost 100% protection was obtained. Even in.5% and.25% concentrations almost 100% protection was obtained as can been seen from the results where protection was in the range of 99.16 to 99.98%. However as the days increased, these concentrations gave almost negligible reduction in the percentage protection.

As far as the percentage mortality is concerned 1% concentration of Parthenium hysterophorus cold extract gave 100% mortality of Callosobruchus chinensis in Cicer kabulium, Lens esculenta and Cicer areitinum in all the 3 solvents used. In.5% and.25% concentrations the percentage mortality gradually increased as the days for observation were increased. This show the gradual effectiveness of the extracts towards the mortality of Callosobruchus chinensis. Best results were observed for acetone extracts in Cicer kabulicum, Lens esculenta and Cicer areitinum, where 100% mortality was observed in 0.5% concentrations after 16 days of observations in these 3 seeds. Comparatively lower percentage mortality was obsreved in.25% concentrations.

Tridex procumbens cold extract :-

Tables XXXII and XXXIII show the datas obtained on percentage protection and percentage mortality respectively when Tridex procumbens cold extracts were used. As per data shown in the table XXXII for percentage protection of Tridex procumbens cold extracts, it can been seen that this extract is also quite effective in protecting the cereals. However with the rise in concentrations for the cold extracts the percentage protection also increased. All the 3 solvent extracts were found to be almost equally effective, almost 100% protection was found in 1% concentrations and even in.5% and.25% concentrations, the percentage protection was not less then 99.19. The percentage mortality recorded in the table XXXIII show good results in acetone extracts as compared to other solvents. 1% concentration gave best results followed by.5 and.25% concentrations. Tridex procumbens cold extracts gave comparatively less percentage mortality in Phaseolus mungo in all the 3 solvents used. Thus acetone solvent extracts appears to be quite effective in protecting the cereals.

Lantana camera cold extract :-

Tables XXXIV and XXXV show the datas obtained on percentage mortality when Lantana camera cold extract was used. In this extract also the results were better with increase in the concentration of extracts. From the table XXXIV it can be observed that 1% concentration gave 100% protection in all the 3 solvents used. In.5% and.25% concentration the percentage protection was 100% or nearly 100% during all the days of observations. All the solvent extracts were almost equally effective in protecting the cereals against Callosobruchus chinensis.

Table XXXV give the datas obtained on the percentage mortality with Lantana camera cold extracts. The percentage mortality was 100% in all the 3 solvents used, when 1% concentration of the extracts were applied for Lantana camera. Methanol extracts proved to be better as compared to the other solvents. The percentage mortality decreased with the percentage concentration of the extracts but the mortality rate increasd with the days of observation. These results on mortality and protection show that the Lantana camera cold extract was IInd most effective extracts coming next to Azadirachta indica.

Ageratum conyzoides cold extract :-

The results obtained on percentage protection and percentage mortality, when Ageratum conyzoides cold extract was used has been given in the tables XXXVI and XXXVII. Table XXXVI give the datas obtained on percentage protection of cereals with Ageratum conyzoides cold extracts. As compared to the extracts of other plants tested this appears to be least effective, all though more than 99% protection was obtained in all the 3 dilutions tested. Its petroleum ether and methanol extracts were found to be better as compared to acetone extracts. These results obtained on percentage mortality show that 1% concentration was better as compared to.5% and.25% concentration. Best results were found in Petroleum ether and methanol extracts, when Cicer kabulicum and Lens esculenta was used. Methanol extract gave better results in Phaseolus mungo. These solvent extracts were less effective in Cicer areitinum.

EXPERIMENT 10 -

Protectant activity of selected plants hot solvent extracts:-

Extracts of the above antifeedant plants were extracted in Petroleum ether, methanol and acetone solvents through soxhlet apparatus and these extracts are named in the present literature as hot solvent extracts. The antifeedant activity of these extracts were observed interms of percentage protection and percentage mortality. The datas obtained has been shown in the tables XXXVIII to XXXXVII.

***Azadirachta indica* hot solvent extract :-**

Tables XXXVII and XXXIX show the datas obtained for antifeedant activity of Azadirachta indica hot solvent extracts. The hot solvent extracts have given very good results for the percentage protection in all the 3 dilutions used as will be evident from the table XXXVII extracts obtained in all the 3 solvents gave almost similar results. However 100% protection was found in 1% extract concentration to 16 days 100% protection was also found in.5% concentrations of the extract upto 8 days. There after the percentage protection showed almost negligible decline upto 16 days. In.25% concentrations very little decline was found upto 16 days. In.25% concentration encongraging results were obtained, which were very good for percentage protection. The decline was not more than 2.2% that too in methanol extract treated with Phaseolus mungo. For rest of the cereals it remained significant. 100% mortality was observed in 1% Azadirachta indica hot solvent extract obtained from the 3 solvents. In.5% and.25% concentrations of the extracts the percentage mortality gradually increased with the increase in duration. Acetone extracts proved to be better as compared to the other solvent extracts, in.5% and.25% concentration. If

comparison is made between the antifeedant activity of hot solvent extracts with that cold solvent extracts it can be observed that hot solvent extracts appeared better in comparison to cold solvent extracts.

***Lantana camera* hot solvent extract :-**

Tables XXXX and XXXXI show the datas obtained on antifeedant activity of Lantana camera hot solvent extracts. The percentage protection with the cereals tested has been shown in the table XXXX. From the results obtained 100% protection can be observed for the cereals tested in 1% concentration. The percentage protection showed an negligible decline, when observed in.5% concentration of the extract. The percentage protection was 100% in Phaseolus mungo in Petroleum ether and methanol extracts after 8 days while upto 16 days there was 99.9% protection. In acetone extracts percentage protection was 99.9% upto 8 days and 99.8% upto 16 days. Cicer kabulicum showed 100% protection in Petrolium ether extract upto 12 days and 99.9% upto 16 days. The methanol extracts showed 100% protection upto 16 days. While acetone extract showed 100% protection upto 8 days and 99.9%, 99.7% upto 12 and 16 days Phaseolus radiatus with extract of Lantana camera showed hundred protection upto 8 days and 99.9%, 99.8% upto 12 and 16 days. Methanol extract gave 100% protection upto 12 days and 99.9% upto 16 days. Acetone extract gave 99.9%, 99.8%, 99.6% and 99.2% protection after 4,8,12 and 16 days respectively. Lens esculenta was 100% protective in Petroleum ether and methanol extract upto 12 days and 99.9% and 100% upto 12 and 16 days. Acetone extract gave 100% protection upto 8 days, 99.8% and 99.7% upto 12 and 16 days. Cicer areitinum showed 100% protective upto 16 days while acetone extract were 100% protection upto 12 days and 99.9% upto 16 days..25% concentrations of the extracts also gave good

results, as can be observed from the above table. In which percentage protection ranged from 100% to 99.2%.

Datas obtained in percentage mortality has been shown in the table XXXXI, when Lantana camera hot solvent extract was used. As per datas recorded 100% mortality was observed in 1% concentrations from the extracts obtained in all the 3 solvents. The percentage mortality decreased in.5% and.25% concentrations. Methanol extracts gave 100% mortality, when seeds of Cicer kabulicum, Lens esculenta and Cicer areitinum were treated with.5% concentrations as observed after 4,8,12 and 16 days. The percentage mortality in.5% and.25% concentration gradually increased with increase in the durations of observation. This showed that with increase in time the beetles of Callosobruchus chinensis has increased death rate. Methanol extracts appeared to be better as compared to the other solvent extracts, as for as the percentage mortality is concerned.

Parthenium hysterophorus hot solvent extract :-

Datas obtained for percentage protection and percentage mortality against Callosobruchus chinensis of Parthenium hysterophorus hot solvent extract has been recorded in the tables XXXXII and XXXXIII respectively. The datas recorded in the table XXXXII for percentage protection showed better results in 1% concentration, as compared to.5% and.25% concentration. In none of the concentration the percentage protection was less than 99.1%. Almost 100% protection was observed in 1% concentration of the extracts obtained in all the 3 solvents. The results obtained for acetone extract gave better protection as compared to the other two solvents. In all the cereals tested negligible decline can be observed, when the concentration of the extract was reduced to.5% concentration.100%

protection was observed upto 8 days for Phaseolus mungo in acetone extracts., Cicer kabulicum in all the solvent extracts., Cicer kabulicum in all the solvent extracts., Phaseolus radiatus in acetone., Lens esculenta and Cicer areitinum in all the extracts. The methanol extracts in.25% concentration gave 100% protection upto 8 days for Cicer kabulicum, Lens esculenta and Cicer areitinum. From these datas it is evident that Parthenium hysterophorus hot solvent extract is quite efficient in protecting the cereals, even in.25% concentrations.

Datas obtained on the percentage mortality has been shown in the table XXXXIII 100% mortality has been obtained in 1% concentration with Cicer kabulicum, Lens esculenta and Cicer areitinum. Methanol extract showed least mortality as compared to the other solvent extracts. The percentage mortality increased with increase in the days of observations. It indicates the delayed lethal effects of Parthenium hysterophorus extract on Callosobruchus chinensis. In Phaseolus mungo and Phaseolus radiatus. The percentage mortality was upto 30% and 50% in.25% concentage after 16 days. This is the least mortality percentage observed in the presence of Parthenium hysterophorus extracts.

Tridex procumbens hot solvent extract :-

The datas obtained on percentage protection and percentage mortality after the treatment the Tridex procumbens hot solvent extracts have been given in the tables XXXXIV and XXXXV.

Table XXXXIV show the datas on the percentage protection. From the datas obtained it is clear that the percentage protection increased with the increased concentration of the extracts. 100% protection was

observed in 1% concentration for Cicer kabulicum, Lens esculenta and Cicer areitinum in all the 3 solvent extracts. Phaseolus radiatus showed 100% protection in petroleum ether and acetone extracts upto 16 days. While methaol extracts gave 100% protection upto 8 days and there after 99.9% and 99.8% after 12 and 16 days. Phaseolus mungo gave 100% protection in acetone extracts upto 12 days and 99.9% after 16 days. In petroleum ether and methanol extracts 100% protection was observed upto 4 days there after it was 99% upto 16 days..5% concentration also gave 100% protection upto 8 days in Lens esculenta, Cicer areitinum was least protected, but achieved to 99.4% protection upto 16 days in all the solvents used. In.25% concentration extracts obtained in all the 3 solvents gave good results. Even upto 16 days the percentage protection was not less than 99.2%.

Percentage mortality has been shown in the table XXXXV. The mortality percentage increased with increase in the days of observations. Which show the delayed lethal effect on the pest beetles. 100% mortality from the beginning was observed for 1% concentration of the extract, when beetles were introduced in extracts treated seeds Cicer kabulicum, Lens esculenta and Cicer areitinum gave the same results as observed in Phaseolus radiatus when treatment was made with petroleum ether and acetone extract. 100% mortality was achieved after 12 and 16 days in Phaseolus radiatus. Similarly 100% mortality was achieved in Phaseolus mungo in Petroleum ether and acetone extracts after 16 days and 90% in methanol extracts..5% and.25% concentration gave less mortality rates. Mortality percentage gradually increased to 100% in Cicer areitinum, Lens esculenta, Cicer kabulicum in all the 3 solvents after 16 days, while acetone extracts in Phaseolus radiatus at.25% concentration appeared to be less effective on the percentage mortality. However its acetone extracts gave good results on Lens esculenta and Cicer areitinum. While methanol extract gave 100% mortality after 16 days in Phaseolus radiatus and Cicer kabulicum.

***Ageratum conyzoides* hot solvent extract :-**

The datas obtained on percentage protection and percentage mortality against Callosobruchus chinensis for Ageratum conyzoides hot solvent extract has been shown in the tables XXXXVI and XXXXVII. This extract appeared to be least effective, when compared with the other plant extracts. The percentage protection and percentage mortality increased in concentration of the extract. In 1% concentration 100% protection was found for Cicer kabulicum, Phaseolus radiatus and Lens esculenta. With petroleum ether & methanol extract upto 16 days of observations. Acetone extracts gave less percentage protection of 99%. Cicer areitinum and Phaseolus mungo were also more than 99% protected in 1% concentration. When the extracts were tested in the dilution of.5% and.25% concentration, the percentage protection was not less then 99%.

The percentage mortality recorded was 100% in petroleum ether and methanol extract for all the days of observation in Cicer kabulicum and Lens esculenta. Similar results were observed in Phaseolus radiatus when treated with methanol extracts. The percentage mortality gradually increased to 100% after 16 days with methanol extract in Phaseolus mungo petroleum ether extracts in Phaseolus radiatus acetone extracts. Lens esculenta and methanol extracts in Cicer areitinum. Gradual increase to 100% mortality was also observed upto 16 days in.5% concentration of methanol extracts for Cicer kabulicum, Phaseolus radiatus and Lens esculenta., Petroleum ether extracts in Phaseolus radiatus and Lens esculenta. In rest of the extract the percentage mortality range between 50% to 90%. The same percentage mortality were observed after 16 days in.25% concentration of the extracts in all the 3 solvents used.

EXPERIMENT 11 –

Protectant Activity Of Selected Plants Essential Oils :

The essential oil of the selected plants were extracted from the aerial parts by Perkins apparatus. The author did not succeed in isolating essential oil from Parthenium hysterophorus. It appears that probably. Parthenium hysterophorus has negligible amount of essential oil. The essential oils isolated from the other 4 plants varied in the viscosity and colour. Oils isolated from Lantana camera and Tridex procumbens were almost transparent very light in colour. While that of Azadirachta indica was highly viscous deep greyish brown in colour with low viscosity. These essential oils were tested for their protectant activity interms of percentage protection of the cereals and percentage mortality of Callosobruchus chinensis. The datas obtained have been given in the tables XXXXVIII and XXXXIX. Since oils from Parthenium hysterophorus could not be obtained therefor it could not be tested and the datas could not be recorded.

Percentage protection given by the rest of the 4 plants on the cereals have been shown in the table XXXXVIII. The percentage activity was observed in 1%,.5% and.25% concentrations of the essential oils. The percentage protection was observed after 5, 10,15 and 20 days. In 1% concentration essential oils obtained from all the plants gave 100% protection to the cereals. In.5% concentration Azadirachta indica again showed 100% protection upto 20 days while Lantana camera and Ageratum conyzoides essential oils showed 100% protection upto 15 days thereafter it reduced to 99.9% after 20 days. The essential oils of Tridex procumbens in.5% concentration gave 100% protection upto 10 days there after 99.9% on 15 and 20 days of application..25% concentration of the essential oils also gave good results and the protection was observed to the degree of 99.9% after 20 days.

Azadirachta indica gave 100% protection upto 10 days, 99.98% and 99.95% after 15 and 20 days. The protectant activity of rest of the 3 essential oils in.25% concentration were almost similar during the different days of observation.

The datas recorded on the percentage mortality of Callosobruchus chinensis by essential oils have been shown in the table XXXXIX. As will be evident from the table, 1% concentration of Lantana camera, Azadirachta indica and Ageratum conyzoides gave 100% mortality on 5,10,15 and 20 days.

Tridex procumbens gave low mortality initially while the mortality percentage increased upto 100%. It gave 70% mortality after 5 days, 90% after 10 days and 100% after 15 and 20 days..5% concentration initially gave low mortality rate which gradually increased to 100% after 15 to 20 days. Essential oils of Azadirachta indica gave 100% mortality during 4 periods of observation. Lantana camera.5% concentration became next to Azadirachta indica where 80% mortality was observed after 5 days which increased to 100% after 10,15 and 20 days. Essential oil of Tridex procumbens and Ageratum conyzoides gave almost similar results where initial after 5 days the percentage mortality was 60-80% after 10 days 80-90% while after 15-20 days 100%. In.25% concentration the percentage mortality further decreased. Lantana camera, Azardirachta india, Tridex procumbens and Ageratum conyzoides gave 70%, 80%, 20% and 60% mortality respectively after 5 days, 80%, 90% 50% and 70% respectively after 10 days. 90%, 100%, 70% and 80% respectively after 15 days, while 100%, 80% and 90% after 20 days. The over all results showed that the essential oils were more effective as insecticidal agents. There ingredients increased the percentage protection and percentage mortality. The results obtained during

the previous experiment on extract are effectively duplicated by essential oils. These oils could be definitely used for the development of antifeedant drugs or insecticidal tablets. These plant have ingredients which have a lethal effect and at the same time protective ability for the cereals. Therefore they can be used in storage godowns to protect our cereals without disturbing the ecosystem.

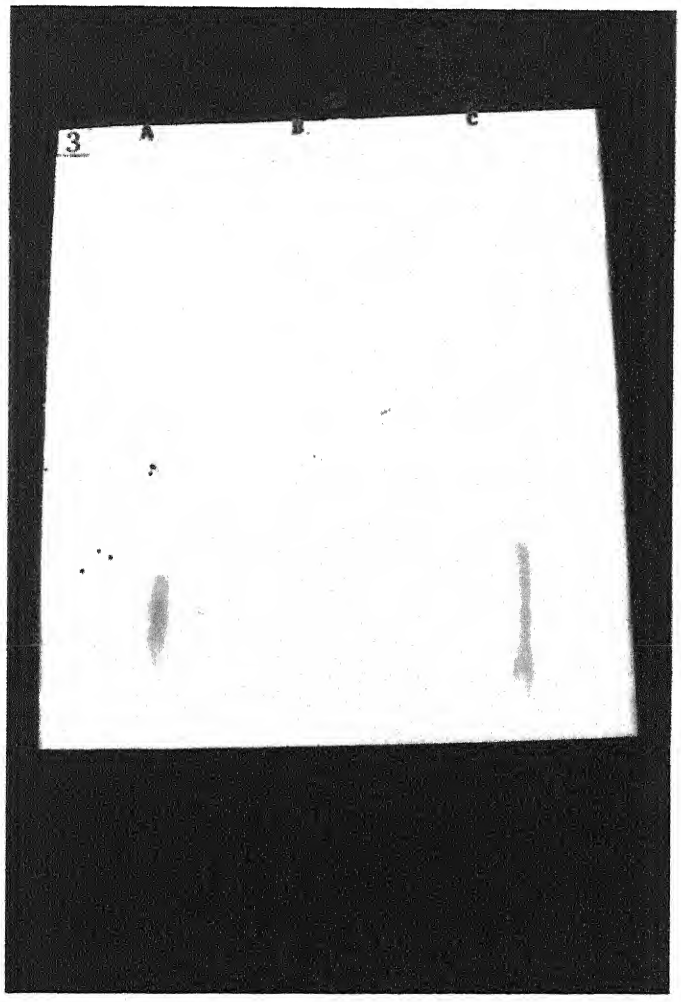
EXPERIMENT 12 AND EXPERIMENTS 13

Isolation Of Active Principle And Structural Elucidation :

The solvent extracts pulp of aerial plants were applied on chromatographic paper Whatman 3MM paper and the spot obtained by descending run using solvent system BAW (4:1:5) were visualised by exposing our ammonia vapour and UV light through ultraviolet lamp equipped with two 15 watt Black-ray tubes and covered with a glass plate. The chromatograms, were observed through protective glasses the UV spt appeared blue-purple in colour with Rf value =.98. This spot was of Lantana camera solvent extract. The spots appeared from the solvent extract of Tridex procumbens and Ageratum conyzoides exhibited the same colour and Rf value both the spots appeared deep purple in colour and gave the Rf value =.79.It appears that both the spots are of the same chemical compound. The chromatogram spotted by Parthenium hysterophorus solvent extract also appeared deep purple in colour. It gave Rf value of.46. The solvent extract of Azardirachta indica when spotted and developed gave of a fluorescent yellow coloured spot with the Rf value =.59. Descending paper chromatograms of selected plants shown in the Plate No. 11 to 15.

PLATE-11

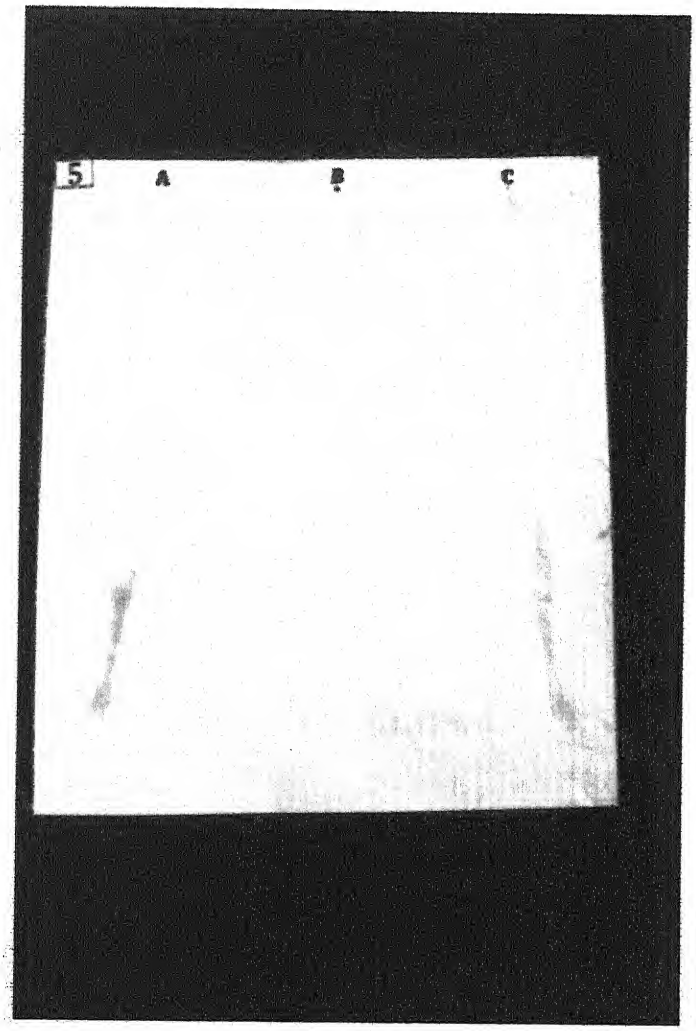
Descending paper chromatograms of Lantana camera plant extract



A- Unknown Sample, B- Unknown Sample, C- Authentic Sample.

PLATE-12

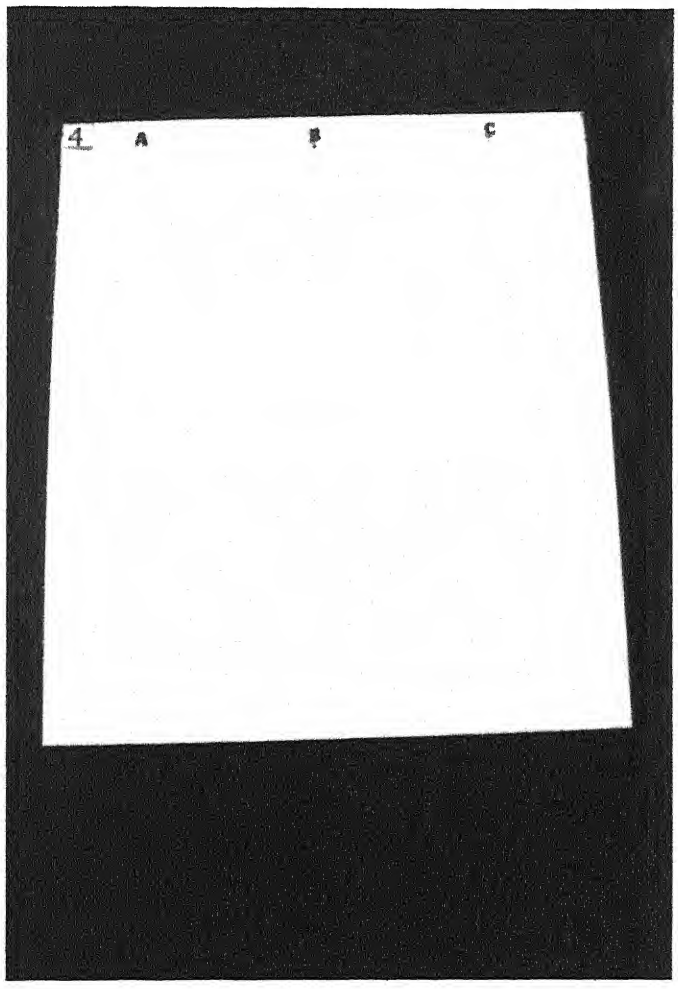
Descending paper chromatograms of Ageratum conyzoides plant extract



A- Unknown Sample, B- Unknown Sample, C- Authentic Sample.

PLATE-13

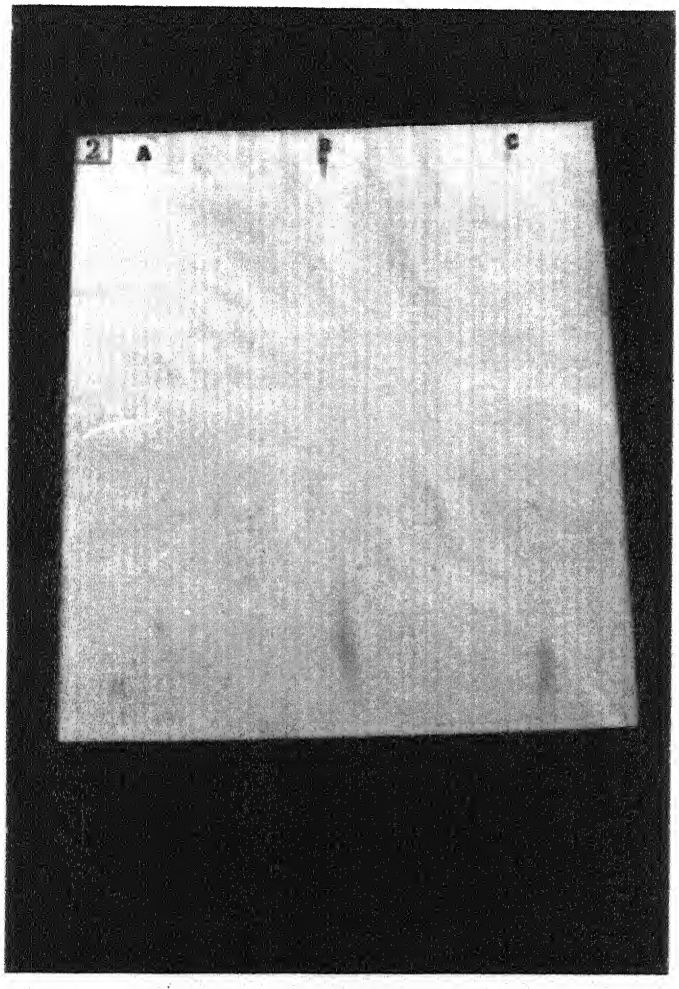
Descending paper chromatograms of Tridex procumbens plant extract



A- Unknown Sample, B- Unknown Sample, C- Authentic Sample.

PLATE-14

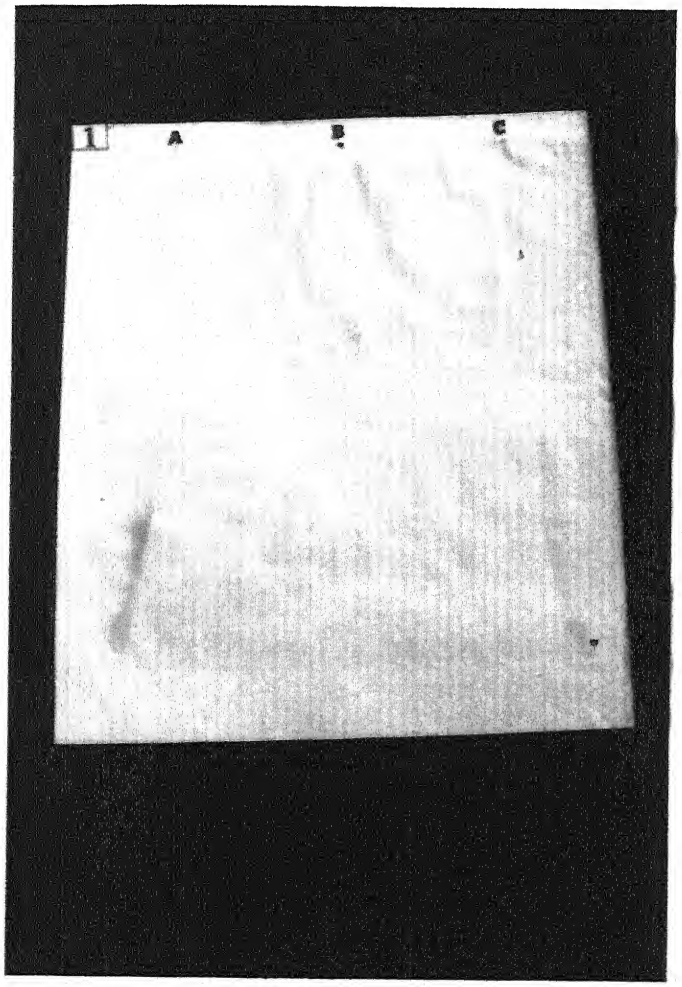
Descending paper chromatograms of Parthenium hysterophorus plant extract



A- Unknown Sample, B- Unknown Sample, C- Authentic Sample.

PLATE - 15

Descending paper chromatograms of Azadirachta indica plant extract

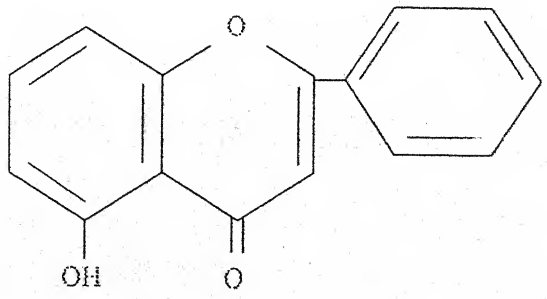


A- Unknown Sample, B- Unknown Sample, C- Authentic Sample.

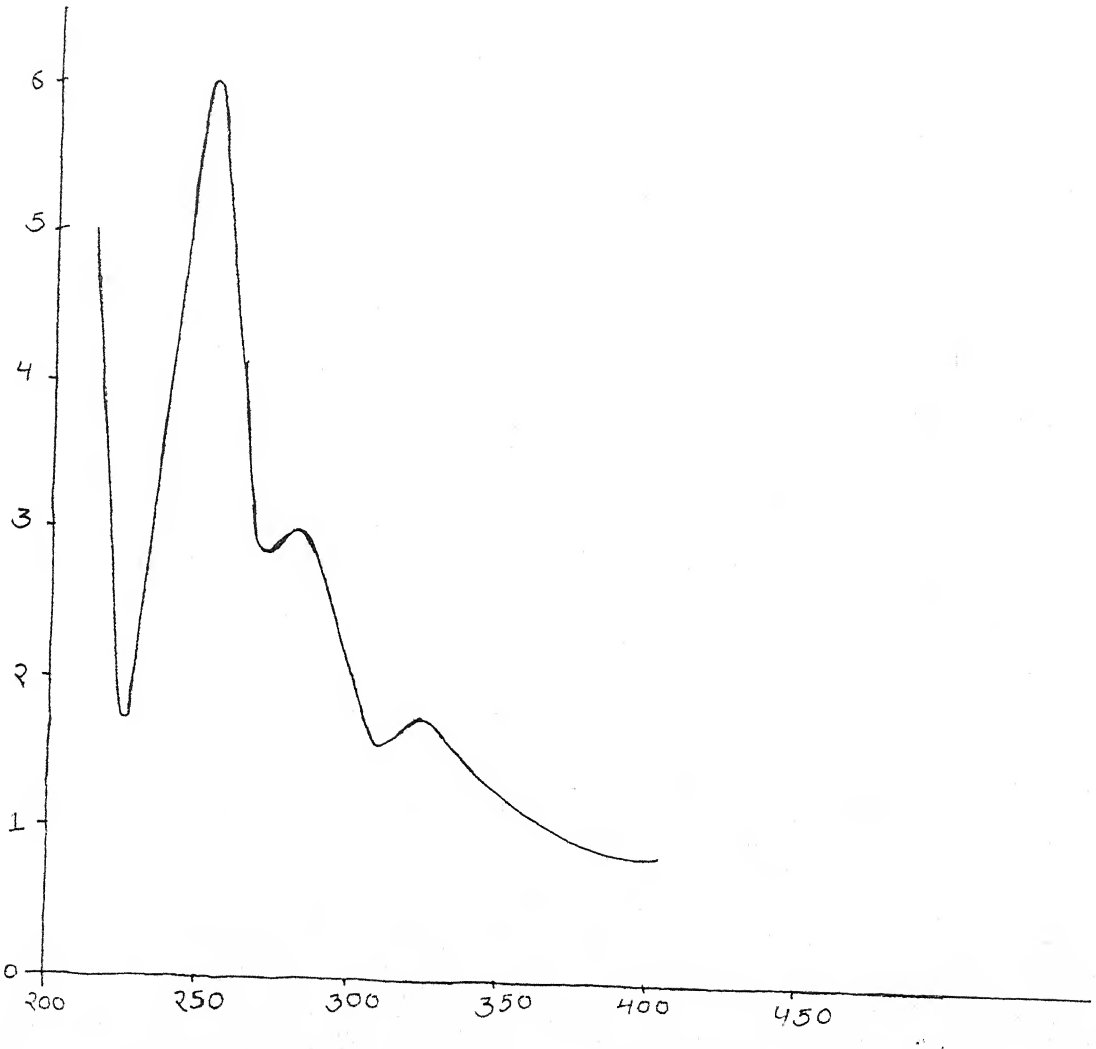
Structure elucidation :

For structural elucidation UV spectra were used all spectra were measured on unichem UV/VIS speoctro photometer, with prism software. The wavelength calibrated was carried out with Holmium oxide filter. Which has λ (MeOH) max at λ 279, λ 287, λ 333, λ 360, λ 418, λ 536 and λ 637 nm. After purification by chromatography. The observed spots were cautiously cut and eluted with spectroscopic grade methanole for UV spectra. All were answering the positive Mg/Hcl (test). The solution was filter and than taken to dryness on a rotary evaporator, the residual thus obtain was redissolved in 10ml of spectral grade methanol. This solution was directly used for UV spectrum analysis. The methanol spectrum was measured at normal scanspeed using 2 to 3 ml of the stock solution. This was rerun at slow scanspeed (about 10 nm per minute) in the region in the peak maxima in order to determined the wavelength (λ) of each maximum more accurately. The methanol spectra exhibited two major absorption peaks in the region λ 240-λ 400nm. These peaks referred to as Band I and Band II. Band I is considered to be associated with absorption due to the B-ring chinnamoyl system and Band II with absorption involving the A-ring benzoyl system.

The UV spectra of Lantana camera extract showed 3 bands at the wavelength λ 250, λ 278 and λ 325nm respectively as shown in spectra 1. Which were, conceding with that of 500 hydroxy flavone. The structure obtained of the flavonoid is as follows :

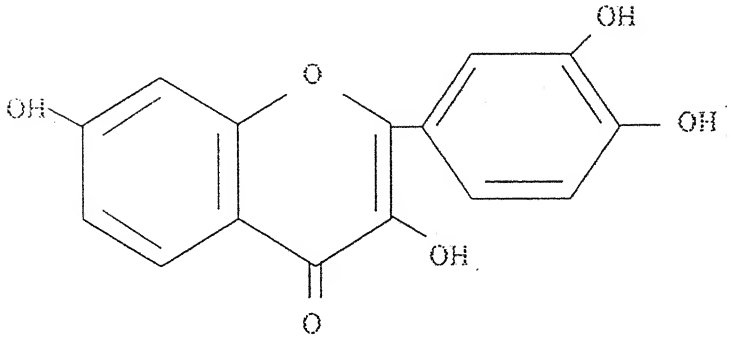


Spectra 1

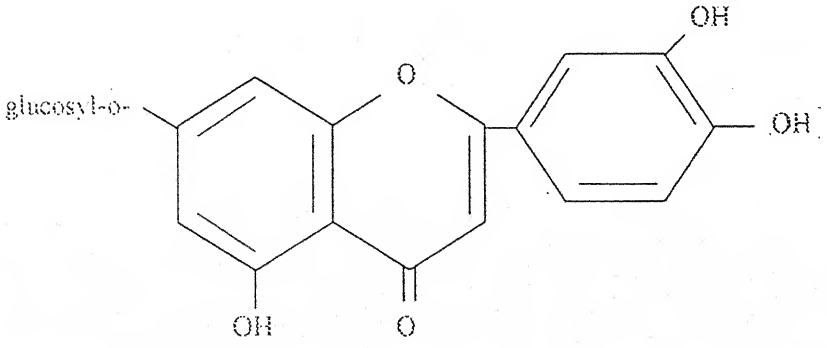


UV Spectrum of Lantana camera methanolic extract

The UV spectrum of Ageratum conyzoides and Tridex procumbens solvent extract showed 5 bands at the wavelength at λ 232, λ 243, λ 257, λ 281 and λ 339nm as shown in the spectra 2. The identified flavounoid could be. Luteolin.

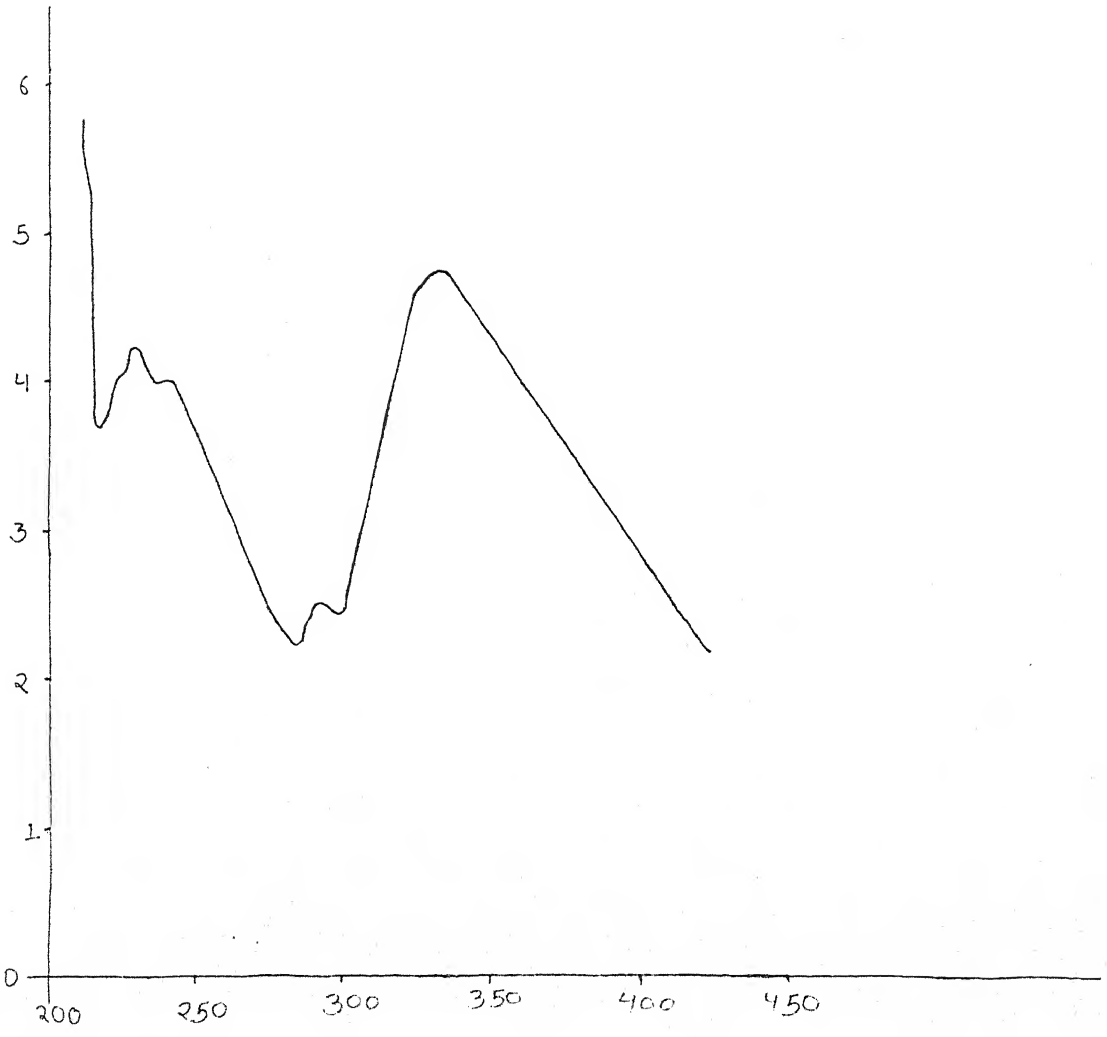


The parthenium hystreopharus solvent extract under UV spectrum showed 3 bands at λ 250, λ 262 and λ 343nm. On the basic spectral evidences and Co-Pc with authentic spectrum luteolin 7-O-glucoside shown in the spectra 3.



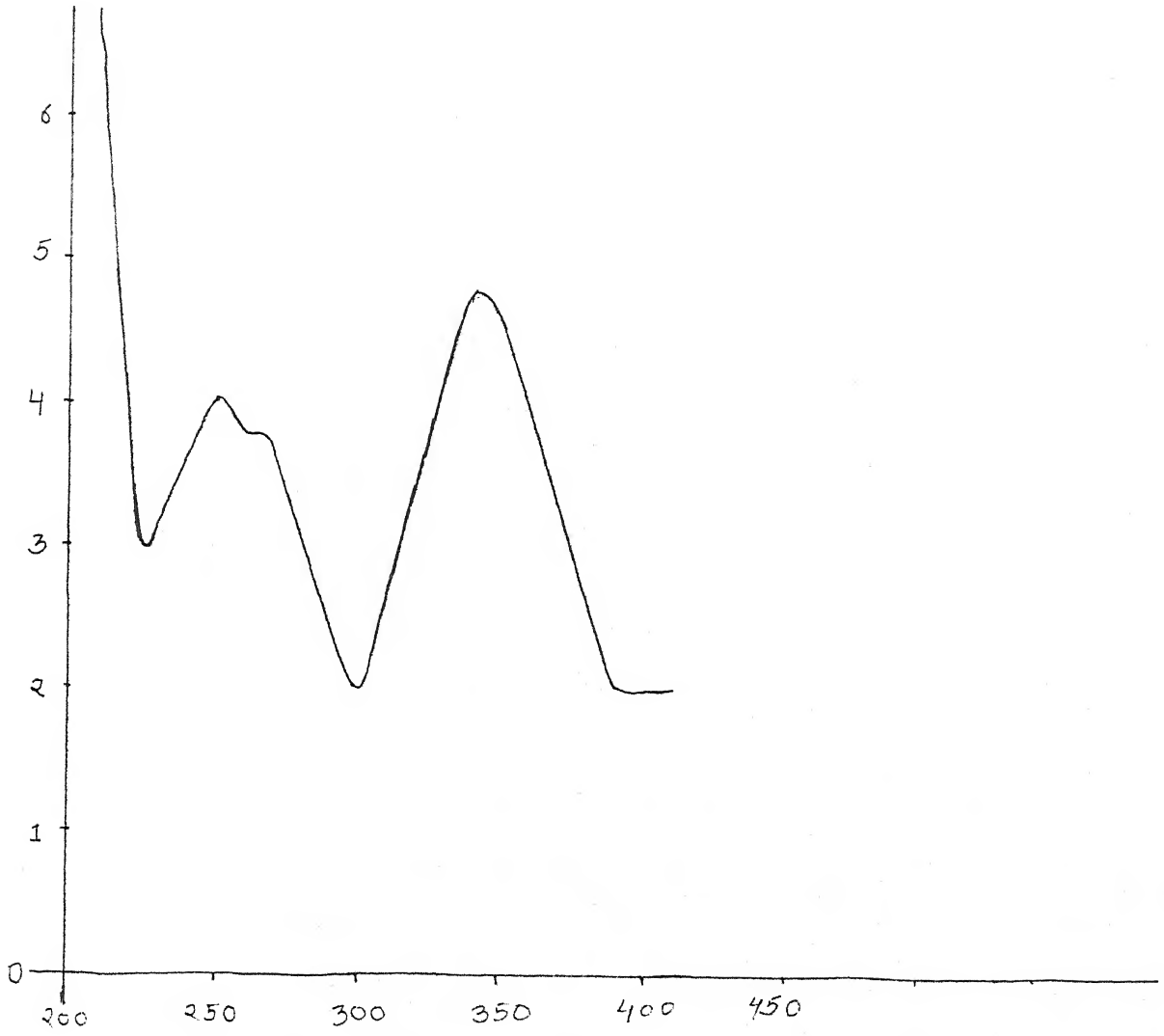
The Azadirachta indica solvent under UV spectra gave 5 bands at λ 239, λ 253, λ 298, λ 310 and λ 353nm.

Spectra 2



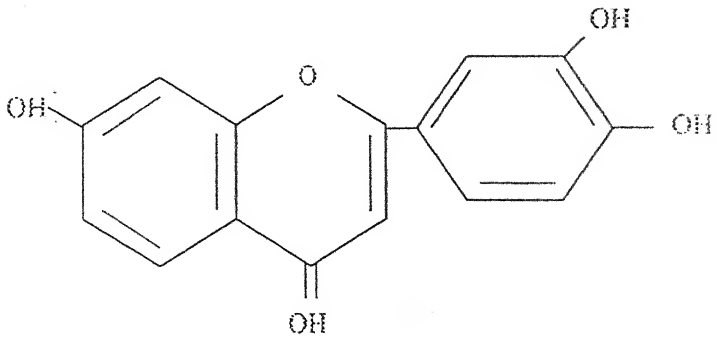
UV Spectrum of Ageratum conyzoides & Tridex procumbens methanolic extract

Spectra 3



UV Spectrum of Parthenium hysterophørus methanolic extract

The spectrum obtained is shown in the spectra 4 and was identified by Co-Pc and U.V. spectrum as -.



The above structure is of the compound fisetin. The spots and the UV spectrum of the plant solvent extracts were confirmed with the spot and spectra data of authentic substances.

EXPERIMENTS 14 -

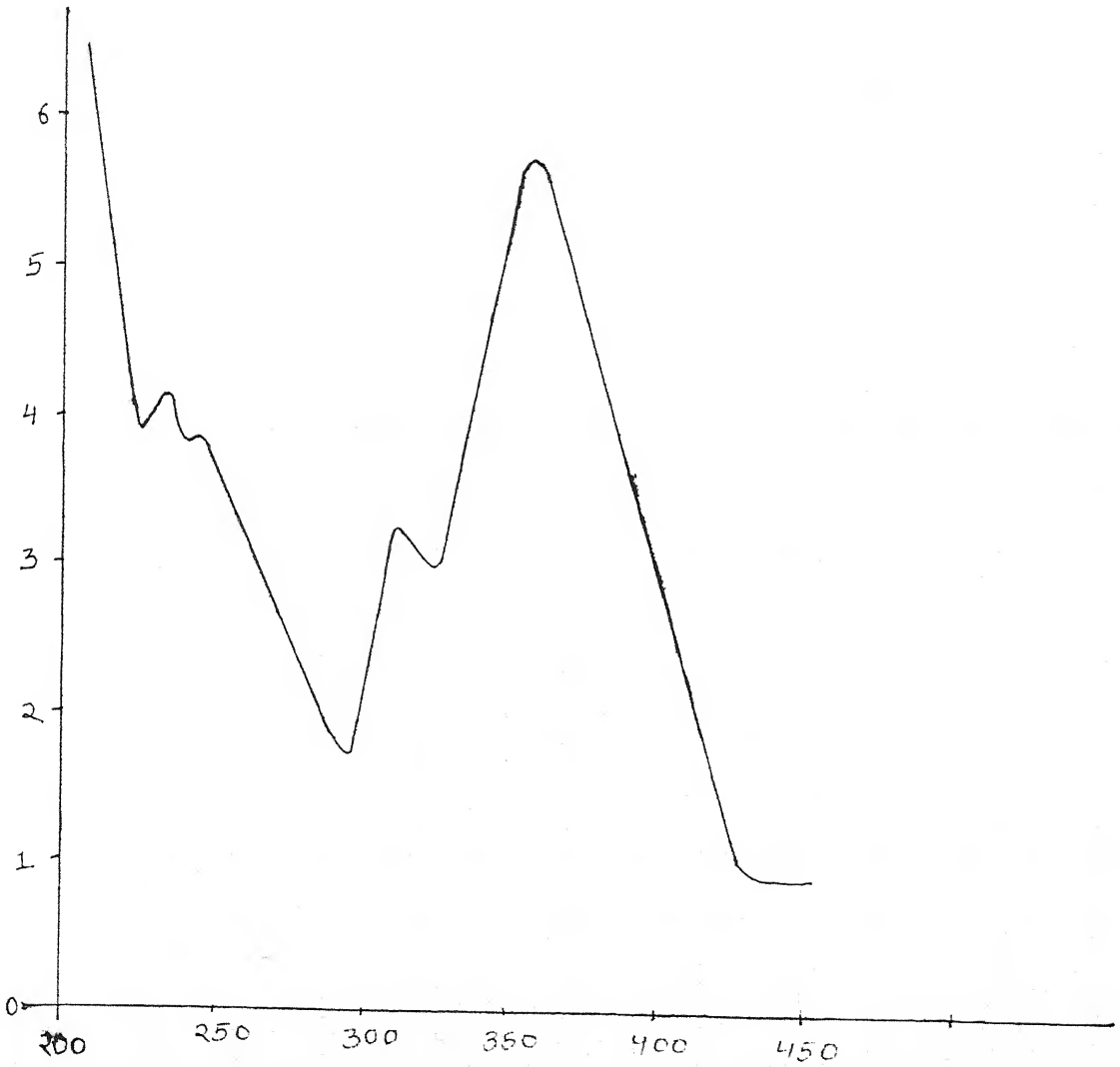
Protection Actively Of Isolate Principle :

The active substance obtained from the 3mm chromatographic paper were taken to dryness under rotary vaccum pump was redissolved in spectroscopic methanol and than were used directly for the study of protected activity of the cereals after 10 days and the datas obtained has been shown in the Table L to LVI.

The chromatographically obtained substance of Lantana cemera showed 100% protection of the cereals Cicer kabulicum, Phaseolus mungo and Phaseolus radiatus while on Lens esculenta and Cicer areitinum 90% protection was noted.

The protectant activity of the active compound obtained after chromatography of Tridex procumbens and Ageratum conyzoides solvent extracts gave the same substance. It protectant activity was less as compare to

Spectra 4



UV Spectrum of Azadirachta indica methanolic extract

the substance obtained from the other plants solvent extracts. This chromatographic extract showed 90% protectant active for Cicer kabulicum, Phaseolus mungo and Phaseolus radiatus while 80% protectant activity was observed for Lens esculenta and Cicer areitinum.

The chromatographic extracts obtained from Parthenium hysterophorus showed 100% protectant activity from Cicer kabulicum and Phaseolus mungo. 90% protectant activity was obtained for Phaselous radiatus and Lens esculenta while 80% protectant activity was obtained of Cicer areitinum.

The active substance obtained chromatographically through Azardirachta indica solvent extract showed highest protectant acivity. All the 5 cereals tested showed 100% protection.

EXPERIMENT 15 -

Isolation And Identification Of Surface Fungal Flora From Experimental Cereals :

From the isolation studies fungal flora were isolated from the 5 cereals which were used for protectant activity during storage. These isolation were carried through suspension obtained after saking the seeds in sterilized water there after seeds were, separately placed on poured petri plates. In all, 18 species of fungus were isolated belonging to 8 genera the largest number of species were obtained from the genus Aspergillus. These were Aspergillus niger, Aspergillus ustus, Aspergillus sydowi, A. Aspergillus Flavaus, Aspergillus lanosum, Aspergillus fumigatus, Aspergillus clavatus and Aspergillus quadrilineatas. 4 species of mucor were isolated out of which 3 were identified and one species could not be identified upto the species level

these were Mucor ambiguus, M. varians, M. bacillifomis & the 4th unidentified M. species. The 6 other genera obtained were Alternaria tenuis, Colletotrichum species, Pellicularia filamentosa, Absidia species, Penicillium species and Rhizopus cohnii. These species were identfied through standard mono graphs & live authentic cultures present in the lab. Data as obtained have been shown in the Table LV.

EXPERIMENT 16 -

Test For Antifungal Activity of Plant Water Extracts :-

The antifungal activity of water extracts obtained from Parthenium hysterophorus, Tridex procumbens, Lantana camera, Azadirachta indica and Ageratum conyzoides were studied on all the fungus isolated in the previous experiment. The retarding effect of the plant extracts were studied on the radial growth of the fungus on Potato dextrose Agar seeded with water extracts of the antifeedant plants. The effect of extracts on the radial growth was observed after every 24 hour to 120 hours. The data recorded has been given in the Table LVI as well as Fig. LVI (A) show that Parthenium hysterophorus has the most effective inhiition on the growth of Aspergillus lanosum, where growth of 13 mm was recording after 96 hours and 16 mm upto 120 hours. Alternaria tenuis, Colletrotrichum spp. and Pellicularia filamentosae were inhibition where radial growth of 30,32 and 33 was recording after 96 hours next to Aspergillus. Next to these organisms Mucor bacilliformis was inhibited where radial growth of 48.5 mm was observed were after 120 hours, after this Mucor varians where 54.5 mm and Aspergillus sydowi 59.5 mm growth was observed, species of Rhizopus Cohnii was found to be the least effective with a full growth of 90 cm. was observed after 48 hours. This was followed by mucor species where full growth was observed

after 72 hours, this was followed by growth of Aspergillus niger and Mucor ambiguus. Where full growth 90 cm. was observed after 96 hours. Rest of the fungus gave intermediate growth between 48.5 mm to 84 mm growth after 120 hours. This show that Parthenium hysterophorus has different retarding effect on different fungus.

When Tridex procumbens water extract was seeded with agar and organisms were grown the maximum inhibitory effects were observed on Aspergillus lanosum, Alternaria tineus, Colletotrichum species and Pellicularia filamentosa, followed by Penicillium species, Mucor varians, Mucor bacilliformis, Aspergillus Flavaus, Aspergillus quadrilineatas and Aspergillus fumigatus. The organism which remain uneffected were Aspergillus niger, Aspergillus ustus, Aspergillus sydowi, Absidia species, Mucor species, Mucor ambiguus and Rhizopus cohnii. These fungal grow to the full size within 72 to 120 hours. Aspergillus clavatus, Aspergillus lanosum could not show any growth upto 120 hours. [Fig. LVI (B)].

Lantana camera water extracts when used with agar produced its maximum inhibitory effect on Aspergillus lanosum where no growth could take place upto 120 hours this was followed by Aspergillus sydowi, Alternaria tineus, Colletrotrichum species and Aspergillus Flavaus, Pellicularia filamentosa, Penicillium species, Aspergillus quadrilineatas and Mucor varians respectively while Aspergillus niger, Aspergillus ustus, Aspergillus fumigatus, Aspergillus M. ambiguus, Mucor varians, M. species and Rhizopus cohnii remained uneffected where full growth was observed after 48 to 72 hours. [Fig. LVI (C)].

Azadirachta indica [Fig. LVI (D)] extracts when used produced maximum inhibitory effect on Aspergillus lanosum followed by Alternaria

tineus, Colletotrichum species, Pellicularia filamentosa, Penicillium species, Aspergillus sydowi, Aspergillus Flavaus, Aspergillus quadrilineatas, Mucor varians and Absidia species respectively. The speies which remain uneffected were Aspergillus niger, Aspergillus ustus, Mucor species, Mucor ambiguus, Mucor bacilliformis and Rhizopus cohnii. Ageratum conyzoides [Fig. LVI (E)] gave significant inhibitory effect on the radial growth of Alternaria tineus Colletotrichum species, Aspergillus lanosum, Aspergillus, quadrilineatas, Penicillium species Pellicularia filamontosa, Aspergillus sydowi and Mucor varians where radial growth of 25 to 36 mm, took place in 120 hours. The organisms which remained uneffected were those of Aspergillus niger, Aspregillus Flavaus, Aspergillus clavatus, Absidia species, Mucor species, Rhizopus cohnii and Mucor bacilliformis. The over all picture leads to the fact that none of the plant water extract could inhibit growth of all the fungus organism. Therefore if combination of extracts could be tried most of the organism may be supressed. Some organisms appeared to be fast growing they covered the petridish within 24 to 120 hours. Their growth remained uneffected by plant water extracts. Rhizopus cohnii appeared to be most uneffected organism. None of the plant water extract could inhibit its radial growth and in the presence of all these extracts its growth covered the entire petridish within 48 hours. This organism was followed by Mucor species coveredthe petridish with in 72 hours in the presence of Parthenium hysterophorus, Tridex procumbens & Lantana camera, plant extract while in the presence of Azadirachta indica and Ageratum conyzoides the petridish was covered with in 96 hours. The rest of the species showed inhibitory effect against some extracts or the other. The most significant growth retarding effect amongst all the plant water extract was observed against Aspergillus lanosum followed by Alternaria tineus, Colletotrichum species, Pellicularia filamentosa, Penicillium species, Mucor varians, Aspergillus sydowi and Penicillium species.

In general the fungal organisms initially showed inhibitory effect which was gradually reduced. Its appearances that the fungus later on adopted it self towards the uncomfortable conditions of the plants water extracts. Some fungal organism also gave a slight inhibitory effect on their spores formation. The results obtained are shown in Fig. LVI (F) to (W).

TABLE NO. – V

Protectant activity of Azadirachta indica plant powders against Callasobruchus chinensis

S.No	Name of Cereals (50 gm.)	Weight of Powder (gm)	Average percentage seeds protected after months		
			4 months	8 months	12months
1.	Phaseolus mungo	2	70	66	60.2
		4	77.96	74	70.3
		5	80.4	80.4	80
2.	Cicer kabulicum	2	92	91.98	86.72
		4	99.96	99.98	97
		5	100	100	99.96
3.	Phaseolus radiatus	2	90.3	88.2	82
		4	99.96	99.96	99.55
		5	100	100	99.92
4.	Lens esculenta	2	80	87.96	85.42
		4	96.2	99.97	95.77
		5	100	100	99.92
5.	Cicer areitinum	2	76.2	74	69.6
		4	84.2	80	74.3
		5	86	84.2	78

TABLE NO. – VI

Protectant activity of Lantana camera plant powders against Callosobruchus chinensis

S.No	Name of Cereals (50 gm.)	Weight of Powder (gm)	Average percentage seeds protected after months		
			4 months	8 months	12months
1.	Phaseolus mungo	2	90.2	88	84.3
		4	96.7	96	88.24
		5	100	100	95.79
2.	Cicer kabulicum	2	78.42	76	73
		4	87.4	84	74
		5	88	86.4	84.02
3.	Phaseolus radiatus	2	68.62	66.62	60
		4	78.82	74.3	72
		5	79.7	77.70	75.68
4.	Lens esculenta	2	84.32	82	76.4
		4	95.93	94	92.4
		5	96	96	95.62
5.	Cicer areitinum	2	88.36	86.98	80
		4	99.96	99.96	97.1
		5	100	100	99.97

TABLE NO. –VII

Protectant activity of Parthenium hysterophorus plant powders against Callosobruchus chinensis

S.No.	Name of cereals	Weight of	Average percentage seeds protected after months		
	(50 gm.)	Powder (gm)	4 months	8 months	12months
1.	Phaseolus mungo	2	84.5	81.78	75.42
		4	92.6	90	88.5
		5	94	92.2	90.2
2.	Cicer kabulicum	2	93.02	90.5	85
		4	99.96	99.1	96
		5	100	100	99.96
3.	Phaseolus radiatus	2	85.42	83	72
		4	92.7	99.5	83.5
		5	93.22	91.62	83.3
4.	Lens esculenta	2	94.9	92.2	87.50
		4	99.96	97.99	95.4
		5	100	100	99.95
5.	Cicer areitinum	2	99.84	93	86.6
		4	99.92	99.96	97.7
		5	100	100	99.55

TABLE NO. – VIII

Protectant activity of Tridex procumbens plant powders against Callosobruchus chinensis

S.No.	Name of Cereals (50 gm.)	Weight of Powder (gm)	Average percentage seeds protected after months		
			4 months	8 months	12months
1.	Phaseolus mungo	2	78.2	76.00	70.24
		4	88.00	76.00	72.3
		5	90.2	86	80
2.	Cicer kabulicum	2	83	80	74
		4	92.00	78	74.2
		5	92.8	92.8	90.8
3.	Phaseolus radiatus	2	89.98	75.98	80
		4	99.99	80.62	97.76
		5	100	100	97.99
4.	Lens esculenta	2	81.99	75.98	67.42
		4	90.24	80.62	77.02
		5	91.82	91.82	87.80
5.	Cicer areitinum	2	73.5	68	66.3
		4	87.99	74.24	71.9
		5	88.4	86.42	82

TABLE NO. – IX

Protectant activity of Ageratum conyzoides plant powders against Callosobruchus chinensis

S.No.	Name of Cereals (50 gm.)	Weight of Powder (gm)	Average percentage seeds protected after months		
			4 months	8 months	12months
1.	Phaseolus mungo	2	84.3	76	68.2
		4	96.34	84.62	82.2
		5	97.34	91.04	88
2.	Cicer kabulicum	2	61.74	80	48.3
		4	90.42	81.23	72.52
		5	91.4	89.4	86.32
3.	Phaseolus radiatus	2	74.42	87.42	60.64
		4	87.74	78.24	72.00
		5	88.32	88.32	87.35
4.	Lens esculenta	2	86.82	75.98	68.42
		4	99.98	99.56	96
		5	100	100	99.97
5.	Cicer areitinum	2	85.62	68	72.62
		4	96.8	85.1	77.1
		5	97.42	97.42	95.12

TABLE NO. – X

Percentage Mortality of Callosobruchus chinensis against Azadirachta indica plant powder

S.No.	Name of Cereals (50 gm.)	Weight of Powder (gm)	Percentage mortality after months		
			4 months	8 months	12months
1.	Phaseolus mungo	2	8700	8700	8800
		4	9300	8700	8000
		5	11000	9640	4100
2.	Cicer kabulicum	2	100	100	1400
		4	100	100	160
		5	300	640	1200
3.	Phaseolus radiatus	2	100	100	160
		4	100	100	160
		5	240	440	580
4.	Lens esculenta	2	100	100	200
		4	100	160	400
		5	200	560	600
5.	Cicer areitinum	2	900	960	1160
		4	1100	1300	1920
		5	4200	5520	5820

TABLE NO.– XI

Percentage mortality of Callsobruchus chinensis against Lantana camera plant powder

S.No	Name of Cereals (50 gm.)	Weight of Powder (gm)	Percentage mortality after months		
			4 months	8 months	12months
1.	Phaseolus mungo	2	100	100	140
		4	102	100	205
		5	172	319	450
2.	Cicer kabulicum	2	1600	1640	1780
		4	2000	2400	3840
		5	4200	5640	6000
3.	Phaseolus radiatus	2	4200	4300	4500
		4	6000	6200	10240
		5	8500	9760	10060
4.	Lens esculenta	2	100	100	140
		4	100	100	180
		5	200	380	500
5.	Cicer areitinum	2	100	100	180
		4	100	100	200
		5	160	360	460

TABLE NO.–XII

Percentage mortality of Callsobruchus chinensis against Parthenium hysterophorus plant powder

S.No	Name of Cereals (50 gm.)	Weight of Powder (gm)	Percentage mortality after months		
			4 months	8 months	12months
1.	Phaseolus mungo	2	3800	3900	4020
		4	4100	4300	6160
		5	8220	9020	9310
2.	Cicer kabulicum	2	100	100	200
		4	100	100	140
		5	220	640	800
3.	Phaseolus radiatus	2	5420	5580	5600
		4	5800	6420	8020
		5	8900	9260	9500
4.	Lens esculenta	2	100	100	160
		4	100	100	160
		5	320	820	1100
5.	Cicer areitinum	2	100	100	180
		4	120	160	420
		5	360	880	1220

TABLE NO.–XIII

Percentage mortality of Callosobruchus chinensis against Tridex procumbens plant powder

S.No.	Name of Cereals (50 gm.)	Weight of Powder (gm)	Percentage mortality after months		
			4 months	8 months	12months
1.	Phaseolus mungo	2	1240	1360	1520
		4	1620	1400	1700
		5	1980	2240	2380
2.	Cicer kabulicum	2	400	400	520
		4	620	660	800
		5	400	700	1280
3.	Phaseolus radiatus	2	100	130	186
		4	107	180	204
		5	114	120	370
4.	Lens esculenta	2	100	100	200
		4	160	240	360
		5	300	700	1940
5.	Cicer areitinum	2	600	600	720
		4	900	1020	1740
		5	1220	1660	1822

TABLE NO. -XIV

Percentage mortality of Callosobruchus chinensis against Ageratum conyzoides plant powder

S.No	Name of cereals (50 gm.)	Weight of Powder (gm)	Percentage mortality after months		
			4 months	8 months	12months
1.	Phaseolus mungo	2	670	680	698
		4	900	940	960
		5	1262	1346	1380
2.	Cicer kabulicum	2	700	720	920
		4	1010	1020	1440
		5	1220	1720	1680
3.	Phaseolus radiatus	2	900	900	980
		4	440	960	1020
		5	1260	1440	1882
4.	Lens esculenta	2	100	200	300
		4	420	500	600
		5	620	830	912
5.	Cicer areitinum	2	254	260	352
		4	456	584	700
		5	820	966	1100

TABLE NO. –XV

Protectant activity of composite samples of 5 plant powders

S.No	Name of cereals (50 gm)	Weight of Composite Sample	Average percentage protection after days	
			10 days	30 days
1.	Cicer kabulicum	5 gm	100	100
2.	Phaseolus mungo	5 gm	100	100
3.	Phaseolus radiatus	5 gm	100	100
4.	Lens esculenta	5 gm	100	99.9
5.	Cicer areitinum	5 gm	100	99.00

TABLE NO. –XVI

Percentage mortality of Callosobruchus chinensis against composite sample of 5 plant powders

S. No.	Name of cereals (50 gm)	Weight of Composite Sample	Average percentage mortality after days	
			10 days	30 days
1.	Cicer kabulicum	5 gm	100	100
2.	Phaseolus mungo	5 gm	100	100
3.	Phaseolus radiatus	5 gm	100	100
4.	Lens esculenta	5 gm	80	100
5.	Cicer areitinum	5 gm	80	100

TABLE NO. –XVII

Antifeedant activity of composite sample of 3 plant powders

S. No.	Name of cereals (50 gm)	Weight of Composite Sample	Average percentage protection after days	
			10 days	30 days
1.	Cicer kabulicum	5 gm	100	100
2.	Phaseolus mungo	5 gm	100	100
3.	Phaseolus radiatus	5 gm	100	100
4.	Lens esculenta	5 gm	100	100
5.	Cicer areitinum	5 gm	100	100

TABLE NO. – XVIII

Percentage protection of Azadirachta indica distilled water extract soaked cereals against Callosobruchus chinensis

S.No.	Name of cereals	Average percentage cereals protected after 10 days		
		1.0% concentration	2.0% concentration	3.0% concentration
1.	Phaseolus mungo	97.83	98.66	97.77
2.	Cicer kabulicum	97.69	98.76	99.31
3.	Phaseolus radiatus	97.00	98.00	99.78
4.	Lens esculenta	97.90	98.76	99.93
5.	Cicer areitinum	97.71	97.83	98.28

TABLE NO. – XIX

Percentage mortality of Callosobruchus chinensis against Azadirachta indica distilled water extract soaked cereals Callosobruchus chinensis

S. No.	Name of cereals	Percentage mortality after different days in different concentration								
		1.0% concentration			2.0 % concentration			3.0% concentration		
		4th day	7th day	10th day	4th day	7th day	10 day	4th day	7th day	10th day
1.	Phaseolus mungo	20	40	60	50	60	70	50	80	90
2.	Cicer kabulicum	60	70	70	40	60	80	50	70	90
3.	Phaseolus radiatus	50	70	70	50	60	70	50	80	100
4.	Lens esculenta	60	70	70	30	60	90	60	80	100
5.	Cicer areitinum	40	60	80	50	50	80	30	60	90

TABLE NO. XX

Percentage Protection of Parthenium hysterophorus distilled water extract soaked cereals against Callosobrucus chinensis

S.No.	Name of cereals	Average cereals protected after 10 days		
		1.0% concentration	2.0% concentration	3.0% concentration
1.	Phaseolus mungo	99.31	98.55	96.87
2.	Cicer kabulicum	97.32	98.95	99.04
3.	Phaseolus radiatus	97.65	97.97	98.07
4.	Lens esculenta	97.81	97.91	99.12
5.	Cicer areitinum	98.93	98.92	99.59

TABLE NO. – XXI

Percentage mortality of Callosobruchus chinensis against Parthenium hysterophorus distilled water extract soaked cereals

S. No.	Name of cereals	Percentage mortality after different days in different concentration								
		1.0% concentration			2.0 % concentration			3.0% concentration		
		4th day	7th day	10th day	4th day	7th day	10 day	4th day	7th day	10th day
1.	Phaseolus mungo	10	20	40	40	50	60	40	50	80
2.	Cicer kabulicum	30	50	60	20	50	60	40	70	100
3.	Phaseolus radiatus	10	20	30	40	50	60	40	60	80
4.	Lens esculenta	10	10	20	20	50	70	30	60	90
5.	Cicer areitinum	20	60	60	40	60	70	40	70	100

TABLE NO. – XXII

Percentage protection of Ageratum conyzoides distilled water extract soaked cereals against Callosobruchus chinensis

S.No.	Name of cereals	Average percentage cereals protected after 10 days		
		1.0% concentration	2.0% concentration	3.0% concentration
1.	Phaseolus mungo	97.49	98.96	98.97
2.	Cicer kabulicum	97.31	98.86	93.75
3.	Phaseolus radiatus	97.33	98.93	98.75
4.	Lens esculenta	97.60	98.92	99.27
5.	Cicer areitinum	96.96	98.83	98.70

TABLE NO. – XXIII

Percentage mortality of Callosobruchus chinensis against Ageratnum conyzoides distilled water extract soaked cereals

S. No.	Name of cereals	Percentage mortality after different days in different concentration								
		1.0% concentration			2.0 % concentration			3.0% concentration		
		4th day	7th day	10th day	4th day	7th day	10 day	4th day	7th day	10th day
1.	Phaseolus mungo	10	30	40	30	40	50	30	40	70
2.	Cicer kabulicum	20	40	60	50	70	70	40	60	90
3.	Phaseolus radiatus	20	50	50	20	40	50	40	60	90
4.	Lens esculenta	30	40	60	40	50	60	50	70	100
5.	Cicer areitinum	30	40	50	10	50	60	20	60	90

TABLE NO. – XXIV

Percentage protection of Tridex procumbens distilled water extract soaked cereals against Callosobruchus chinensis

S.No.	Name of cereals	Average percentage cereals protected after 10 days		
		1.0% concentration	2.0% concentration	3.0% concentration
1.	Phaseolus mungo	95.42	98.94	99.33
2.	Cicer kabulicum	97.63	98.50	99.11
3.	Phaseolus radiatus	97.81	98.80	99.20
4.	Lens esculenta	97.61	97.91	99.30
5.	Cicer areitinum	97.77	98.85	96.66

TABLE NO. – XXV

Percentage mortality of Callosobruchus chinensis against Tridex procumbens distilled water extract soaked cereals

S. No.	Name of cereals	Percentage mortality after different days in different concentration								
		1.0% concentration			2.0 % concentration			3.0% concentration		
		4th day	7th day	10th day	4th day	7th day	10 day	4th day	7th day	10th day
1.	Phaseolus mungo	10	20	80	60	70	70	30	60	60
2.	Cicer kabulicum	20	30	50	10	60	70	50	30	80
3.	Phaseolus radiatus	30	40	60	70	80	80	40	70	90
4.	Lens esculenta	100	20	60	50	60	80	40	60	70
5.	Cicer areitinum	10	50	90	50	60	90	20	60	90

TABLE NO. – XXVI

Percentage protection of Lantana camera distilled water extract soaked cereals against Callosobruchus chinensis

S.No.	Name of cereals	Average percentage cereals protected after 10 days		
		1.0% concentration	2.0% concentration	3.0% concentration
1.	Phaseolus mungo	95.25	98.88	99.18
2.	Cicer kabulicum	92.33	97.14	92.12
3.	Phaseolus radiatus	95.66	98.65	97.19
4.	Lens esculenta	97.78	98.72	97.28
5.	Cicer areitinum	97.53	97.69	99.28

TABLE NO. – XXVII

Percentage mortality of Callosobruchus chinensis against Lantana camera distilled water extract soaked cereals

S. No.	Name of cereals	Percentage mortality after different days in different concentration								
		1.0% concentration			2.0 % concentration			3.0% concentration		
		4th day	7th day	10th day	4th day	7th day	10 day	4th day	7th day	10th day
1.	Phaseolus mungo	40	60	100	40	70	80	50	80	100
2.	Cicer kabulicum	20	30	100	20	30	40	30	50	90
3.	Phaseolus radiatus	50	70	100	30	50	70	40	60	80
4.	Lens esculenta	60	70	100	50	60	70	40	60	90
5.	Cicer areitinum	20	60	100	50	60	80	50	80	100

TABLE NO. –XXVIII

Percentage protection of Callosobruchus chinensis against Azadirachta indica cold solvent extract soaked cereals

S. No.	Name of cereals	Solvent used for extraction	Percentage protection after different days and different concentration											
			1% concentration				0.5% concentration				0.25% concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	100	100	100	100	100	100	98.36	98.24	100	99.68	98.3	98.19
		Y	100	100	100	100	100	100	98.37	97.97	100	99.77	98.25	97.77
		Z	100	100	100	100	100	100	100	99.8	100	100	99.86	99.62
2.	Cicer kabulicum	X	100	100	100	100	100	100	100	99.87	100	100	99.85	99.61
		Y	100	100	100	100	100	100	100	99.91	100	100	99.89	99.84
		Z	100	100	100	100	100	100	100	100	100	100	99.9	99.91
3.	Phaseolus radiatus	X	100	100	100	100	100	100	100	99.81	100	100	99.79	99.68
		Y	100	100	100	100	100	100	100	99.81	100	100	99.81	99.75
		Z	100	100	100	100	100	100	100	100	100	100	100	99.9
4.	Lens esculenta	X	100	100	100	100	100	100	100	99.9	100	100	99.89	99.81
		Y	100	100	100	100	100	100	100	99.97	100	100	99.9	99.87
		Z	100	100	100	100	100	100	100	100	100	100	100	99.98
5.	Cicer areitinum	X	100	100	100	100	100	100	99.8	99.57	100	99.87	99.69	99.48
		Y	100	100	100	100	100	100	99.82	99.67	100	99.89	99.72	99.57
		Z	100	100	100	100	100	100	100	99.87	100	100	99.84	99.81

Solvent Index – **X** – Petroleum ether, **Y**- Methanol, **Z**- Acetone

TABLE NO. – XXIX

Percentage mortality of Callosobruchus chinensis against Azadirachta indica cold solvent extract soaked cereals

S. No.	Name of cereals	Solvent used for extraction	Percentage mortality after different days and different concentration											
			1% concentration				0.5% concentration				0.25% concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	100	100	100	100	50	60	80	100	50	70	80	120
		Y	100	100	100	100	60	70	80	90	50	50	70	90
		Z	100	100	100	100	60	70	80	100	60	60	70	80
2.	Cicer kabulicum	X	100	100	100	100	70	80	90	100	60	60	70	80
		Y	100	100	100	100	80	90	90	100	70	80	80	100
		Z	100	100	100	100	100	100	100	100	70	80	90	100
3.	Phaseolus radiatus	X	100	100	100	100	70	80	80	100	60	80	90	100
		Y	100	100	100	100	80	80	90	100	60	70	80	90
		Z	100	100	100	100	100	100	100	100	80	90	90	100
4.	Lens esculenta	X	100	100	100	100	70	80	90	100	70	70	80	90
		Y	100	100	100	100	80	80	90	100	70	70	80	90
		Z	100	100	100	100	100	100	100	100	80	90	90	100
5.	Cicer areitinum	X	100	100	100	100	70	80	80	90	60	60	70	80
		Y	100	100	100	100	70	80	90	100	60	60	70	90
		Z	100	100	100	100	80	80	100	100	70	80	90	100

Solvent Index – **X** – Petroleum ether, **Y** – Methanol, **Z** - Acetone

TABLE NO. –XXX

Percentage protection of Parthenium hysterophorus cold solvent extract soaked cereals against Callosobruchus chinensis

S. No.	Name of cereals	Solvent used for extraction	Percentage protection after different days and different concentration											
			1% concentration				0.5% concentration				0.25% concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	100	100	100	100	100	99.9	99.74	99.3	99.9	99.73	99.51	99.27
		Y	100	100	99.95	98.7	100	99.81	99.64	99.26	99.88	99.62	99.29	99.16
		Z	100	100	100	100	100	100	100	99.36	99.88	99.86	99.55	99.28
2.	Cicer kabulicum	X	100	100	100	100	100	100	100	99.9	100	99.97	99.78	99.95
		Y	100	100	100	100	100	100	99.86	99.48	99.91	99.88	99.77	99.37
		Z	100	100	100	100	100	100	100	100	100	100	99.99	99.96
3.	Phaseolus radiatus	X	100	100	100	100	100	99.87	99.72	99.37	99.9	99.74	99.63	99.29
		Y	100	100	99.96	99.72	100	99.81	99.64	99.26	99.89	99.66	99.31	99.19
		Z	100	100	100	100	100	100	99.73	99.37	99.9	99.88	99.57	99.31
4.	Lens esculenta	X	100	100	100	100	100	100	100	99.91	100	99.96	99.87	99.69
		Y	100	100	100	100	100	100	99.87	99.59	99.91	99.88	99.75	99.28
		Z	100	100	100	100	100	100	100	100	100	100	99.92	99.88
5.	Cicer areitinum	X	100	100	100	100	100	100	100	99.92	100	99.96	99.87	99.78
		Y	100	100	100	100	100	100	99.77	99.72	99.9	99.76	99.68	99.56
		Z	100	100	100	100	100	100	100	100	100	100	99.98	99.83

Solvent Index – **X** – Petroleum ether, **Y** – Methanol, **Z** - Acetone

TABLE NO. – XXXI

Percentage mortality of Callosobruchus chinensis against Parthenium hysterophorus cold solvent extract soaked cereals

S. No.	Name of cereals	Solvent used for extraction	Percentage mortality after different days and different concentration											
			1% concentration				0.5% concentration				0.25% concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	50	60	80	100	40	50	50	60	30	30	40	60
		Y	20	30	40	60	10	30	30	50	10	10	20	40
		Z	70	80	80	90	10	20	20	40	30	60	50	60
2.	Cicer kabulicum	X	100	100	100	100	70	80	80	90	60	70	70	80
		Y	100	100	100	100	60	70	80	90	40	40	50	60
		Z	100	100	100	100	80	80	90	100	60	60	70	80
3.	Phaseolus radiatus	X	40	50	70	80	40	40	50	60	30	30	40	50
		Y	10	20	30	50	10	30	40	70	10	10	30	50
		Z	70	80	90	100	10	20	20	50	10	10	20	40
4.	Lens esculenta	X	100	100	100	100	60	70	80	90	50	50	60	80
		Y	100	100	100	100	50	60	70	70	40	40	50	60
		Z	100	100	100	100	100	100	100	100	60	70	90	90
5.	Cicer arietinum	X	100	100	100	100	70	80	80	90	50	60	70	70
		Y	100	100	100	100	50	50	60	70	40	50	60	60
		Z	100	100	100	100	60	70	80	100	60	70	80	80

Solvent Index – **X** – Petroleum ether, **Y** – Methanol, **Z** - Acetone

TABLE NO. –XXXII

Percentage protection of Tridex procumbens cold solvent extract soaked cereals against Callosobruchus chinensis

S. No.	Name of cereals	Solvent used for extraction	Percentage protection after different days and different concentration											
			1% concentration				0.5% concentration				0.25% concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	100	99.91	99.82	99.68	99.89	99.87	99.63	99.46	99.88	99.62	99.42	99.19
		Y	100	99.94	99.86	99.74	99.93	99.89	99.66	99.46	99.85	99.77	99.46	99.2
		Z	100	100	100	99.95	99.9	99.87	99.73	99.54	99.88	99.84	99.56	99.28
2.	Cicer kabulicum	X	100	100	100	100	100	99.98	99.57	99.36	99.89	99.84	99.36	99.21
		Y	100	100	100	100	100	100	99.62	99.51	99.9	99.89	99.58	99.38
		Z	100	100	100	100	100	100	99.69	99.63	99.91	99.86	99.61	99.34
3.	Phaseolus radiatus	X	100	100	100	100	99.93	99.86	99.69	99.31	99.87	99.77	99.57	99.21
		Y	100	100	99.89	99.84	100	99.89	99.78	99.65	99.9	99.87	99.59	99.48
		Z	100	100	100	100	100	99.93	99.88	99.78	99.91	99.89	99.7	99.51
4.	Lens esculenta	X	100	100	100	100	100	100	99.9	99.28	99.9	99.88	99.69	99.48
		Y	100	100	100	100	100	100	99.9	99.74	100	99.9	99.82	99.58
		Z	100	100	100	100	100	100	100	99.77	100	100	99.92	99.61
5.	Cicer areitinum	X	100	100	100	100	100	100	99.89	99.61	99.89	99.88	99.57	99.46
		Y	100	100	100	100	100	100	99.9	99.64	100	99.89	99.8	99.52
		Z	100	100	100	100	100	100	100	99.95	100	100	99.94	99.57

Solvent Index – **X** – Petroleum ether, **Y** – Methanol, **Z** - Acetone

TABLE NO. –XXXIV

Percentage protection of Lantana camera cold solvent extract soaked cereals against Callosobruchus chinensis

S. No.	Name of cereals	Solvent used for extraction	Percentage protection after different days and different concentration											
			1% concentration				0.5% concentration				0.25% concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	100	100	100	100	100	100	99.88	99.8	99.87	99.71	99.4	99.3
		Y	100	100	100	100	100	100	99.93	99.89	99.88	99.85	99.58	99.47
		Z	100	100	100	100	99.97	99.87	99.85	99.77	99.88	99.7	99.38	99.27
2.	Cicer kabulicum	X	100	100	100	100	100	100	100	99.9	99.89	99.89	99.7	99.57
		Y	100	100	100	100	100	100	100	100	100	100	99.91	99.85
		Z	100	100	100	100	100	100	99.88	99.77	99.91	99.81	99.80	99.41
3.	Phaseolus radiatus	X	100	100	100	100	100	100	99.89	99.8	99.88	99.85	99.61	99.27
		Y	100	100	100	100	100	100	100	100	99.99	99.86	99.74	99.57
		Z	100	100	100	100	99.94	99.87	99.62	99.27	99.89	99.86	99.54	99.17
4.	Lens esculenta	X	100	100	100	100	100	100	100	99.96	100	100	99.88	99.77
		Y	100	100	100	100	100	100	100	100	100	100	100	99.89
		Z	100	100	100	100	100	100	99.7	99.7	99.93	99.86	99.77	99.60
5.	Cicer areitinum	X	100	100	100	100	100	100	100	100	100	100	99.9	99.87
		Y	100	100	100	100	100	100	100	100	100	100	100	99.91
		Z	100	100	100	100	100	100	100	99.89	100	100	99.9	99.86

Solvent Index – X – Petroleum ether, **Y** – Methanol, **Z** - Acetone

TABLE NO. –XXXV

Percentage mortality of Callosobruchus chinensis against Lantana camera cold solvent extract soaked cereals

S. No.	Name of cereals	Solvent used for extraction	Percentage mortality after different days and different concentration											
			1% concentration				0.5% concentration				0.25% concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	100	100	100	100	70	80	80	90	40	50	50	60
		Y	100	100	100	100	60	70	80	90	60	60	70	80
		Z	100	100	100	100	20	40	60	60	10	30	40	60
2.	Cicer kabulicum	X	100	100	100	100	70	80	90	100	60	70	70	80
		Y	100	100	100	100	100	100	100	100	70	80	90	90
		Z	100	100	100	100	70	70	80	80	40	50	50	60
3.	Phaseolus radiatus	X	100	100	100	100	70	80	80	90	40	50	50	60
		Y	100	100	100	100	60	70	80	80	50	50	60	80
		Z	100	100	100	100	30	30	30	50	10	30	40	60
4.	Lens esculenta	X	100	100	100	100	70	80	90	100	50	60	60	80
		Y	100	100	100	100	100	100	100	100	70	80	90	100
		Z	100	100	100	100	60	60	80	90	60	70	80	70
5.	Cicer areitinum	X	100	100	100	100	100	100	100	100	80	80	90	100
		Y	100	100	100	100	100	100	100	100	80	80	90	100
		Z	100	100	100	100	80	80	90	100	60	70	80	90

Solvent Index – **X** – Petroleum ether, **Y** – Methanol, **Z** - Acetone

TABLE NO. –XXXVI

Percentage protection of Ageratum conyzoides cold solvent extract soaked cereals against Callosobruchus chinensis

S. No.	Name of cereals	Solvent used for extraction	Percentage protection after different days and different concentration											
			1% concentration				0.5% concentration				0.25% concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	99.99	99.93	99.77	99.56	99.93	99.86	99.57	99.36	99.91	99.79	99.36	99.20
		Y	100	99.97	99.9	99.86	99.91	99.83	99.68	99.59	99.9	99.81	99.67	99.5
		Z	99.9	99.83	99.71	99.54	99.84	99.7	99.54	99.2	99.71	99.51	99.28	99.11
2.	Cicer kabulicum	X	100	100	100	100	100	99.9	99.72	99.57	99.95	99.88	99.61	99.35
		Y	100	100	100	100	100	100	99.75	99.46	99.78	99.74	99.65	99.33
		Z	99.98	99.95	99.85	99.49	99.9	99.85	99.41	99.3	99.85	99.48	99.25	99.2
3.	Phaseolus radiatus	X	100	100	100	100	100	100	99.98	99.95	100	99.97	99.94	99.92
		Y	100	100	100	100	100	100	100	99.91	100	99.97	99.96	99.95
		Z	99.96	99.91	99.84	99.74	99.93	99.84	99.70	99.53	99.9	99.76	99.57	99.38
4.	Lens esculenta	X	100	100	100	100	100	100	99.91	99.74	100	99.97	99.84	99.68
		Y	100	100	100	100	100	100	100	99.95	100	99.99	99.96	99.94
		Z	99.97	99.9	99.78	99.5	99.92	99.79	99.49	99.51	99.9	99.69	99.29	99.24
5.	Cicer areitinum	X	100	99.98	99.91	99.77	99.95	99.89	99.61	99.48	99.93	99.79	99.58	99.27
		Y	100	100	99.88	99.65	100	99.96	99.74	99.41	99.97	99.89	99.64	99.27
		Z	99.92	99.86	99.74	99.58	99.9	99.72	99.41	99.28	99.75	99.40	99.24	99.15

Solvent Index – **X** – Petroleum ether, **Y** – Methanol, **Z** - Acetone

TABLE NO. –XXXVII

Percentage mortality of Callosobruchus chinensis against Ageratum conyzoides cold solvent extract soaked cereals

S. No.	Name of cereals	Solvent used for extraction	Percentage mortality after different days and different concentration											
			1% concentration				0.5% concentration				0.25% concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	30	40	70	80	20	30	40	70	10	20	50	70
		Y	60	70	100	100	50	50	80	90	30	50	60	70
		Z	30	40	60	80	10	40	40	90	10	40	50	90
2.	Cicer kabulicum	X	100	100	100	100	60	60	70	80	50	50	60	70
		Y	100	100	100	100	80	90	100	100	50	60	60	90
		Z	50	50	60	60	20	30	40	70	30	30	50	70
3.	Phaseolus radiatus	X	60	80	90	100	50	60	80	100	30	60	70	80
		Y	100	100	100	100	80	90	90	100	60	70	70	80
		Z	50	60	70	90	40	60	70	80	60	70	70	80
4.	Lens esculenta	X	100	100	100	100	60	70	80	100	40	60	80	90
		Y	100	100	100	100	80	90	100	100	50	70	80	90
		Z	30	50	60	80	40	50	60	80	50	50	70	70
5.	Cicer areitinum	X	50	60	70	80	40	50	70	80	30	40	70	80
		Y	70	70	80	100	60	70	80	90	30	50	60	70
		Z	30	50	50	60	20	30	50	70	10	30	50	70

Solvent Index – **X** – Petroleum ether, **Y** – Methanol, **Z** - Acetone

TABLE NO. –XXXVIII

Percentage protection of Azadirachta indica hot solvent extract soaked cereals against Callosobruchus chinensis

S. No.	Name of cereals	Solvent used for extraction	Percentage protection after different days and different concentration											
			1% concentration				0.5% concentration				0.25 % concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	100	100	100	100	100	100	98.4	98.25	100	99.69	98.32	98.2
		Y	100	100	100	100	100	100	98.38	97.99	100	99.78	98.27	97.8
		Z	100	100	100	100	100	100	100	99.8	100	100	99.87	99.63
2.	Cicer kabulicum	X	100	100	100	100	100	100	100	99.89	100	100	99.87	99.7
		Y	100	100	100	100	100	100	100	99.92	100	100	99.9	99.86
		Z	100	100	100	100	100	100	100	100	100	100	99.91	99.94
3.	Phaseolus radiatus	X	100	100	100	100	100	100	100	99.82	100	100	99.8	99.7
		Y	100	100	100	100	100	100	100	99.85	100	100	99.83	99.77
		Z	100	100	100	100	100	100	100	100	100	100	100	99.91
4.	Lens esculenta	X	100	100	100	100	100	100	100	99.91	100	100	99.9	99.83
		Y	100	100	100	100	100	100	100	99.98	100	100	99.91	99.89
		Z	100	100	100	100	100	100	100	100	100	100	100	99.98
5.	Cicer areitinum	X	100	100	100	100	100	100	99.81	99.58	100	99.89	99.70	99.49
		Y	100	100	100	100	100	100	99.83	99.68	100	99.9	99.75	99.59
		Z	100	100	100	100	100	100	100	99.91	100	100	99.9	99.85

Solvent Index – **X** – Petroleum ether, **Y** – Methanol, **Z** - Acetone

TABLE NO. –XXXIX

Percentage mortality of Callosobruchus chinensis against Azadirachta indica hot solvent extract soaked cereals

S. No.	Name of cereals	Solvent used for extraction	Percentage mortality after different days and different concentration											
			1% concentration				0.5% concentration				0.25% concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	100	100	100	100	60	80	100	60	60	60	60	70
		Y	100	100	100	100	70	80	90	50	50	50	70	90
		Z	100	100	100	100	70	80	100	60	60	80	80	90
2.	Cicer kabulicum	X	100	100	100	100	80	90	90	100	60	60	60	70
		Y	100	100	100	100	90	90	90	100	50	50	70	90
		Z	100	100	100	100	100	100	100	100	60	80	80	90
3.	Phaseolus radiatus	X	100	100	100	100	80	80	90	100	70	80	90	100
		Y	100	100	100	100	80	90	90	100	70	80	90	100
		Z	100	100	100	100	100	100	100	80	80	90	90	100
4.	Lens esculenta	X	100	100	100	100	80	90	90	100	70	80	90	100
		Y	100	100	100	100	80	90	90	100	70	70	80	100
		Z	100	100	100	100	100	100	100	100	90	100	100	100
5.	Cicer areitinum	X	100	100	100	100	80	80	90	100	70	70	80	90
		Y	100	100	100	100	80	80	100	100	70	80	90	100
		Z	100	100	100	100	80	80	100	100	70	80	90	100

Solvent Index – **X** – Petroleum ether, **Y** – Methanol, **Z** - Acetone

TABLE NO. –XXXX

Percentage protection of Lantana camera hot solvent extract soaked cereals against Callosobruchus chinensis

S. No.	Name of cereals	Solvent used for extraction	Percentage protection after different days and different concentration											
			1% concentration				0.5% concentration				0.25% concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	100	100	100	100	100	100	99.9	99.84	99.89	99.79	99.41	99.3
		Y	100	100	100	100	100	100	99.94	99.9	99.9	99.86	99.6	99.49
		Z	100	100	100	100	99.9	99.9	99.89	99.8	99.89	99.71	99.39	99.28
2.	Cicer kabulicum	X	100	100	100	100	100	100	100	99.91	99.9	99.89	99.72	99.59
		Y	100	100	100	100	100	100	100	100	100	100	99.9	99.87
		Z	100	100	100	100	100	100	99.89	99.77	99.91	99.83	99.8	99.43
3.	Phaseolus radiatus	X	100	100	100	100	100	100	99.9	99.81	99.9	99.87	99.66	99.3
		Y	100	100	100	100	100	100	100	99.93	99.99	99.87	99.75	99.58
		Z	100	100	100	99.99	99.96	99.89	99.64	99.29	99.9	99.81	99.57	99.2
4.	Lens esculenta	X	100	100	100	100	100	100	100	99.95	100	100	99.89	99.79
		Y	100	100	100	100	100	100	100	100	100	100	100	99.9
		Z	100	100	100	100	100	100	99.8	99.72	99.94	99.87	99.8	99.63
5.	Cicer areitinum	X	100	100	100	100	100	100	100	100	100	100	99.92	99.89
		Y	100	100	100	100	100	100	100	100	100	100	100	9.993
		Z	100	100	100	100	100	100	100	99.9	100	100	99.91	99.87

Solvent Index – **X** – Petroleum ether, **Y** – Methanol, **Z** - Acetone

TABLE NO. –XXXXI

Percentage mortality of Callosobruchus chinensis against Lantana camera hot solvent extract soaked cereals

S. No.	Name of cereals	Solvent used for extraction	Percentage mortality after different days and different concentration											
			1% concentration				0.5% concentration				0.25% concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	100	100	100	100	80	80	90	100	50	50	50	70
		Y	100	100	100	100	70	80	90	90	60	60	70	90
		Z	100	100	100	100	30	40	30	50	10	30	40	60
2.	Cicer kabulicum	X	100	100	100	100	80	90	90	100	60	60	70	80
		Y	100	100	100	100	100	100	100	100	70	80	80	90
		Z	100	100	100	100	70	70	80	80	40	50	60	90
3.	Phaseolus radiatus	X	100	100	100	100	70	70	80	80	50	50	70	80
		Y	100	100	100	100	80	90	90	100	60	70	80	90
		Z	80	80	90	100	50	50	70	80	30	40	70	100
4.	Lens esculenta	X	100	100	100	100	80	40	90	100	60	60	70	80
		Y	100	100	100	100	100	100	100	100	70	80	80	100
		Z	100	100	100	100	70	70	80	90	60	60	70	80
5.	Cicer ariethinum	X	100	100	100	100	100	100	100	100	80	90	90	100
		Y	100	100	100	100	100	100	100	100	80	80	100	100
		Z	100	100	100	100	80	90	90	100	70	90	90	100

Solvent Index – **X** – Petroleum ether, **Y** – Methanol, **Z** - Acetone

TABLE NO. –XXXXII

Percentage protection of Parthenium hysterophorus hot solvent extract soaked cereals against Callosobruchus chinensis

S. No.	Name of cereals	Solvent used for extraction	Percentage protection after different days and different concentration											
			1% concentration				0.5% concentration				0.25% concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	100	100	100	100	100	99.92	99.76	99.34	99.94	99.64	99.34	99.29
		Y	100	100	99.98	99.85	100	99.83	99.69	99.22	99.89	99.76	99.65	99.29
		Z	100	100	100	100	100	100	99.65	99.49	99.98	99.89	99.77	99.35
2.	Cicer kabulicum	X	100	100	100	100	100	100	100	99.92	100	99.98	99.79	99.56
		Y	100	100	100	100	100	100	99.88	99.5	99.91	99.89	99.79	99.39
		Z	100	100	100	100	100	100	100	100	100	100	99.99	99.98
3.	Phaseolus radiatus	X	100	100	100	100	100	99.91	99.74	99.39	99.92	99.76	99.53	99.29
		Y	100	100	99.97	98.73	100	99.83	99.65	99.28	99.89	99.66	99.3	99.19
		Z	100	100	100	100	100	100	99.75	99.38	99.9	99.88	99.57	99.31
4.	Lens esculenta	X	100	100	100	100	100	100	100	99.93	100	99.98	99.89	99.69
		Y	100	100	100	100	100	100	99.88	99.59	99.92	99.89	99.75	99.29
		Z	100	100	100	100	100	100	100	100	100	100	99.94	99.89
5.	Cicer areitinum	X	100	100	100	100	100	100	100	99.93	100	99.97	99.87	99.78
		Y	100	100	100	100	100	100	99.79	99.74	99.91	99.78	99.69	99.55
		Z	100	100	100	100	100	100	100	100	100	100	99.99	99.84

Solvent Index – **X** – Petroleum ether, **Y** – Methanol, **Z** - Acetone

TABLE NO. –XXXXIII

Percentage mortality of Callosobruchus chinensis against Parthenium hysterophorus hot solvent extract soaked cereals

S. No.	Name of cereals	Solvent used for extraction	Percentage mortality after different days and different concentration											
			1% concentration				0.5% concentration				0.25% concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	60	70	90	100	50	60	60	70	50	60	60	60
		Y	30	50	50	60	20	30	30	40	10	20	30	30
		Z	80	90	100	100	50	50	60	70	40	40	60	70
2.	Cicer kabulicum	X	100	100	100	100	70	80	80	90	60	70	80	80
		Y	100	100	100	100	70	80	80	90	40	40	50	50
		Z	100	100	100	100	80	90	100	100	60	70	70	80
3.	Phaseolus radiatus	X	50	60	80	100	40	50	50	60	30	30	40	50
		Y	10	20	30	50	0	20	30	40	0	0	30	50
		Z	70	80	90	100	10	30	60	70	30	50	50	60
4.	Lens esculenta	X	100	100	100	100	60	80	80	90	50	50	70	80
		Y	100	100	100	100	50	70	70	70	30	50	50	60
		Z	100	100	100	100	100	100	100	100	70	90	90	90
5.	Cicer areitinum	X	100	100	100	100	70	70	80	90	60	60	70	70
		Y	100	100	100	100	50	60	60	80	40	50	60	60
		Z	100	100	100	100	70	80	90	100	70	70	80	80

Solvent Index – **X** – Petroleum ether, **Y** – Methanol, **Z** - Acetone

TABLE NO. –XXXXIV

Percentage protection of Tridex procumbens hot solvent extract soaked cereals against Callosobruchus chinensis

S. No.	Name of cereals	Solvent used for extraction	Percentage protection after different days and different concentration											
			1% concentration				0.5% concentration				0.25% concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	100	99.92	99.83	99.69	99.9	99.88	99.64	99.47	99.88	99.63	99.47	99.2
		Y	100	99.96	99.87	99.75	99.94	99.9	99.68	99.48	99.87	99.79	99.47	99.22
		Z	100	100	100	99.97	99.91	99.89	99.74	99.55	99.89	99.85	99.56	99.29
2.	Cicer kabulicum	X	100	100	100	100	100	99.99	99.58	99.36	99.89	99.84	99.36	99.2
		Y	100	100	100	100	100	100	99.61	99.51	99.91	99.88	99.59	99.39
		Z	100	100	100	100	100	100	99.7	99.64	99.92	99.88	99.63	99.35
3.	Phaseolus radiatus	X	100	100	100	100	99.94	99.87	99.69	99.34	99.9	99.79	99.59	99.23
		Y	100	100	99.91	99.85	100	99.9	99.79	99.66	99.91	99.88	99.6	99.49
		Z	100	100	100	100	100	99.94	99.89	99.79	99.92	99.89	99.70	99.52
4.	Lens esculenta	X	100	100	100	100	100	100	99.91	99.29	99.91	99.89	99.69	99.48
		Y	100	100	100	100	100	100	99.92	99.75	100	99.92	99.83	99.59
		Z	100	100	100	100	100	100	100	99.79	100	100	99.94	99.63
5.	Cicer areitinum	X	100	100	100	100	100	100	99.9	99.63	99.9	99.89	99.58	99.49
		Y	100	100	100	100	100	100	99.92	99.66	100	99.9	99.81	99.53
		Z	100	100	100	100	100	100	100	99.97	100	100	99.95	99.50

Solvent Index – **X** – Petroleum ether, **Y** – Methanol, **Z** - Acetone

TABLE NO. –XXXXV

Percentage mortality of Callosobruchus chinensis against Tridex procumbens hot solvent extract soaked cereals

S. No.	Name of cereals	Solvent used for extraction	Percentage mortality after different days and different concentration											
			1% concentration				0.5% concentration				0.25% concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	70	70	80	100	50	60	70	80	30	50	90	100
		Y	60	60	80	90	30	50	60	90	30	50	70	80
		Z	80	90	90	100	70	70	80	90	60	60	70	60
2.	Cicer kabulicum	X	100	100	100	100	60	70	80	100	40	60	60	100
		Y	100	100	100	100	90	80	100	100	60	70	90	100
		Z	100	100	100	100	80	90	90	100	70	70	80	90
3.	Phaseolus radiatus	X	100	100	100	100	50	60	70	90	50	50	70	80
		Y	80	90	100	100	70	70	80	90	70	70	90	100
		Z	100	100	100	100	80	90	90	100	70	80	80	90
4.	Lens esculenta	X	100	100	100	100	80	90	100	100	80	80	80	80
		Y	100	100	100	100	70	80	90	100	70	70	70	80
		Z	100	100	100	100	80	80	90	100	80	80	80	100
5.	Cicer areitinum	X	100	100	100	100	80	80	100	100	60	70	80	90
		Y	100	100	100	100	90	90	100	100	70	80	100	100
		Z	100	100	100	100	80	90	100	100	90	90	100	100

Solvent Index – **X** – Petroleum ether, **Y** – Methanol, **Z** - Acetone

TABLE NO. –XXXXVI

Percentage protection of Ageratum conyzoides hot solvent extract soaked cereals against Callosobruchus chinensis

S. No.	Name of cereals	Solvent used for extraction	Percentage protection after different days and different concentration											
			1% concentration				0.5% concentration				0.25% concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	99.99	99.93	99.78	99.57	99.94	99.87	99.59	99.38	99.9	99.79	99.38	99.92
		Y	100	99.98	99.91	99.89	99.92	99.84	99.71	99.59	99.9	99.83	99.69	99.51
		Z	99.91	99.80	99.72	99.54	99.85	99.71	99.55	99.23	99.71	99.53	99.29	99.11
2.	Cicer kabulicum	X	100	100	100	100	100	99.92	99.74	99.59	99.97	99.88	99.63	99.36
		Y	100	100	100	100	100	100	99.75	99.54	99.78	99.74	99.66	99.34
		Z	99.98	99.94	99.86	99.50	99.91	99.86	99.41	99.31	99.85	99.49	99.25	99.2
3.	Phaseolus radiatus	X	100	100	100	100	100	100	99.98	99.96	100	99.97	99.95	99.93
		Y	100	100	100	100	100	100	100	99.92	100	99.48	99.97	99.95
		Z	99.96	99.92	99.84	99.75	99.93	99.85	99.71	99.53	99.91	99.76	99.58	99.39
4.	Lens esculenta	X	100	100	100	100	100	100	99.91	99.75	100	99.98	99.84	99.68
		Y	100	100	100	100	100	100	100	99.97	100	99.99	99.97	99.94
		Z	99.91	99.91	99.79	99.51	99.92	99.80	99.49	99.31	99.9	99.69	99.3	99.24
5.	Cicer areitinum	X	100	99.99	99.92	99.79	99.96	99.89	99.62	99.49	99.94	99.79	99.58	99.28
		Y	100	100	99.89	99.66	100	99.97	99.75	99.41	99.97	99.89	99.65	99.28
		Z	99.92	99.86	99.75	99.59	99.9	99.73	99.41	99.28	99.75	99.40	99.25	99.15

Solvent Index – **X** – Petroleum ether, **Y** – Methanol, **Z** - Acetone

TABLE NO. –XXXXVII

Percentage mortality of Callosobruchus chinensis against Ageratum conyzoides hot solvent extract soaked cereals

S. No.	Name of cereals	Solvent used for extraction	Percentage mortality after different days and different concentration											
			1% concentration				0.5% concentration				0.25% concentration			
			4th	8th	12th	16th	4th	8th	12th	16th	4th	8th	12th	16th
1.	Phaseolus mungo	X	40	60	70	90	20	40	60	80	10	30	50	70
		Y	60	70	90	100	50	50	70	80	30	40	40	70
		Z	30	40	60	60	20	30	60	70	10	50	60	90
2.	Cicer kabulicum	X	100	100	100	100	70	70	80	80	50	60	60	70
		Y	100	100	100	100	80	90	90	100	60	60	80	90
		Z	40	60	70	90	30	40	50	60	30	30	40	60
3.	Phaseolus radiatus	X	70	90	100	100	50	70	90	100	30	60	80	90
		Y	100	100	100	100	90	90	100	100	60	70	80	90
		Z	50	60	90	100	40	60	80	90	60	70	70	80
4.	Lens esculenta	X	100	100	100	100	60	70	90	100	30	70	80	90
		Y	100	100	100	100	90	90	100	100	50	60	80	90
		Z	40	50	60	100	40	40	60	80	50	50	70	70
5.	Cicer areitinum	X	50	70	80	90	40	50	70	70	30	50	70	80
		Y	70	80	90	100	60	70	70	90	40	50	60	70
		Z	30	50	50	60	20	30	40	50	10	30	50	50

Solvent Index – **X** – Petroleum ether, **Y** – Methanol, **Z** - Acetone

TABLE NO. – XXXXVIII

Percentage protection of selected plants essential oil

S. No.	Source of essential oils	Percentage protection after days and concentration											
		1.0% concentration				0.5% concentration				0.25% concentration			
		5th	10th	15th	20th	5th	10th	15th	20th	5th	10th	15th	20th
1.	Lantana camera	100	100	100	100	100	100	100	99.96	100	99.98	99.95	99.91
2.	Azadirachta indica	100	100	100	100	100	100	100	100	100	100	99.98	99.95
3.	Tridex procumbens	70	90	100	100	100	100	99.95	99.98	100	99.97	99.92	99.88
4.	Ageratum conyzoides	100	100	100	100	100	100	100	99.95	100	99.98	99.95	99.90

TABLE NO. – XXXXIX

Percentage mortality in presence of selected plants essential oil during different days and concentration

S. No.	Source of essential oils	Mortality after days days and concentration											
		1.0% concentration				0.5% concentration				0.25% concentration			
		5th	10th	15th	20th	5th	10th	15th	20th	5th	10th	15th	20th
1.	Lantana camera	100	100	100	100	80	100	100	100	70	80	90	100
2.	Azadirachta indica	100	100	100	100	100	100	100	100	80	90	100	100
3.	Tridex procumbens	70	90	100	100	60	80	100	100	20	50	70	80
4.	Ageratum conyzoides	100	100	100	100	80	90	100	100	60	70	80	90

TABLE NO. L

Protectant activity of crystalized chromatographic solvent extracts of Lantana camera

S. No.	Name of the cereals	Average cereals protected after 10 days
1.	Cicer kabulicum	100
2.	Phaseolous mungo	100
3.	Phaseolous radiatus	100
4.	Lens esculenta	90
5.	Cicer areitinum	90

TABLE NO. LI

Protectant activity of crystalized chromatographic solvent extracts of Tridex procumbens

S. No.	Name of the cereals	Average cereals protected after 10 days
1.	Cicer kabulicum	90
2.	Phaseolous mungo	90
3.	Phaseolous radiatus	90
4.	Lens esculenta	80
5.	Cicer areitinum	80

TABLE NO. LII

Protectant activity of crystalized chromatographic solvent extracts of Ageratum conyzoides

S. No.	Name of the cereals	Average cereals protected after 10 days
1.	Cicer kabulicum	90
2.	Phaseolous mungo	90
3.	Phaseolous radiatus	90
4.	Lens esculenta	80
5.	Cicer areitinum	80

TABLE NO. LIII

Protectant activity of crystalized chromatographic solvent extracts of Parthenium hysterophorus

S. No.	Name of the cereals	Average cereals protected after 10 days
1.	Cicer kabulicum	100
2.	Phaseolous mungo	100
3.	Phaseolous radiatus	90
4.	Lens esculenta	90
5.	Cicer areitinum	80

TABLE NO. LIV

Protectant activity of crystalized chromatographic solvent extracts of Azadirachta indica

S. No.	Name of the cereals	Average cereals protected after 10 days
1.	Cicer kabulicum	100
2.	Phaseolous mungo	100
3.	Phaseolous radiatus	100
4.	Lens esculenta	100
5.	Cicer areitinum	100

TABLE NO. LV

Seeds Mycoflora isolated from the cereals

S.No.	Isolated number	Name of the fungal genera	Name of species
1.	018&20	Aspergillus	niger
2.	038&19	Aspergillus	ustus
3.	028&30	Aspergillus	sydowi
4.	048&23	Aspergillus	flavaus
5.	058&22	Aspergillus	lanosum
6.	068&25	Aspergillus	Fumigatus
7.	088&32	Aspergillus	clavatus
8.	098&33	Aspergillus	Quadrilineater
9.	078&17	Absidia	species
10.	0108&16	Mucor	species
11.	0118&21	Mucor	ambiguus
12.	0138&26	Mucor	varians
13.	0128&27	Mucor	bacilliformis
14.	0148&28	Penicillium	species
15.	0158&29	Rhizopus	cohnii
16.	018&35	Alternaria	tenuis
17.	024&34	Colletotrechum	species
18.	030&36	Pellicularia	filamentosa

TABLE – LVI

Test for antifungal activity of plant's water extracts on isolated fungus

Isolated fungus tested	Parthenium hysterophorus Extracts					Tridex procumbens Extract					Lantana camera Extract					Azadirachta indica Extract					Ageratum conyzoides Extract				
Hrs. •	24	48	72	96	120	24	48	72	96	120	24	48	72	96	120	24	48	72	96	120	24	48	72	96	120
1. Aspergillus niger	5	55	85	90	90	15	80	84	90	90	19	90	90	90	90	25	90	90	90	90	29	90	90	90	90
2. Aspergillus ustus	11.5	45	64.5	85	87.5	24	50	75	85	90	24.5	59.5	85	88	90	22	75	89	80	90	30	90	90	90	90
3. Aspergillus sydowi	7	7	46.5	47.5	59.5	29.5	39	40	70	90	7	8	11	21	25	7	10	12	26	28	7	21.5	26.5	29.3	35
4. Aspergillus flavaus	7	7	41.5	77	82.5	10	24	37	58.5	71	9	25.5	32.5	37.5	40	8	18	26	30	39	9	32.5	80	90	90
5. Aspergillus lanosum	7	7	7	13	16	7	7	7	7	7	7	7	7	7	7	7	7	8	9	12	7	22.5	26.5	28	30
6. Aspergillus fumigatus	20	40.5	58	67.5	78	13	34	50	61.5	75.5	5	30	57.5	70	85	9	31	44.9	55	62.5	12.5	28	40	51.5	59
7. Aspergillus clavatus	7	7	7	7	7	7	7	7	7	7	37.5	90	90	90	90	18	30	48	60	88	20.5	85	89	90	90
8. Aspergillus quadrilineatas	9	32.5	48	66	82	12	27.5	35	55.5	72	7	9	26.5	42.5	64	7	22.5	26	34.5	50.5	7	9	19	21	30
9. Absidia species	10	31	56.5	73.5	84	14.5	50	71.5	85	90	7	24.5	35	60	77.5	7.5	29.5	42.5	57.5	68.5	25	80	80	90	90
10. Mucor species	27.5	61	90	90	90	25	73.5	90	90	90	21.5	65	90	90	90	12.5	50	80	90	90	15	52.5	82.5	90	90
11. Mucor ambiguus	7	7	82	90	90	19.5	85	90	90	90	33	67.5	89	90	90	25	80	82.5	88	90	20	36	48.5	50	55
12. Mucor varians	7	21.5	29.5	44.5	54.5	10	30	41	54.5	64.5	10	22.5	40	49	62	5	19	33	42	53	10.5	17	20	30	36
13. Mucor bacilliformis	7	7	27	37	48.5	7	9	28.5	50	65	23.5	90	90	90	90	23	90	90	90	90	22.5	60	82.5	86	89
14. Penicillium species	7	7	39	60	64.5	30.5	42.5	45	53.5	55.5	8.5	20	23.5	24.5	40	4.5	15	19	21	25	10	22.5	27.5	29	30
15. Rhizopus eohnii	26.6	90	90	90	90	20.6	90	90	90	90	48	90	90	90	90	22	88	90	90	90	32.5	90	90	90	90
16. Alternaria tenuis	7	13	20	30	41	7	12	15	20	25	7	10	15	21	24	7	7	9	12	15	7	12	18	23	27
17. Colletotrechum species	9	17	23	32	40	9	19	25	31	39	8	12	17	24	30	7	7	9	14	16	7	11	16	21	25
18. Pellicularia filamentosa	11	18	25	33	41	10	20	28	37	45	9	27	29	31	35	7	7	9	15	23	9	15	26	25	35

Redial growth measured in mm.

Fig. LVI (A) Test for antifungal activity of Parthenium hysterophorus plant water extract

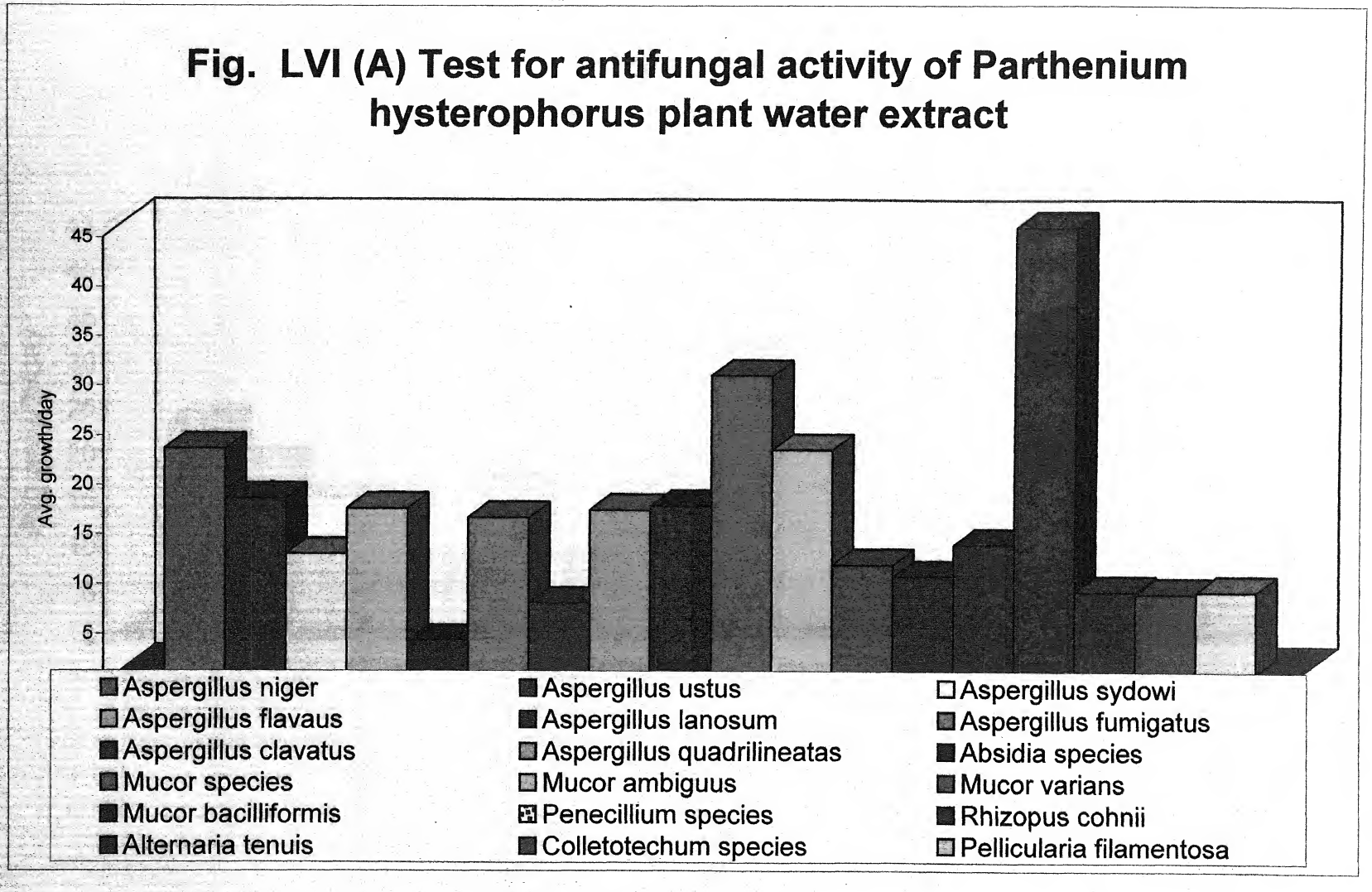


Fig. LVI (B) Test for antifungal activity of Tridex procumbens plant water extract

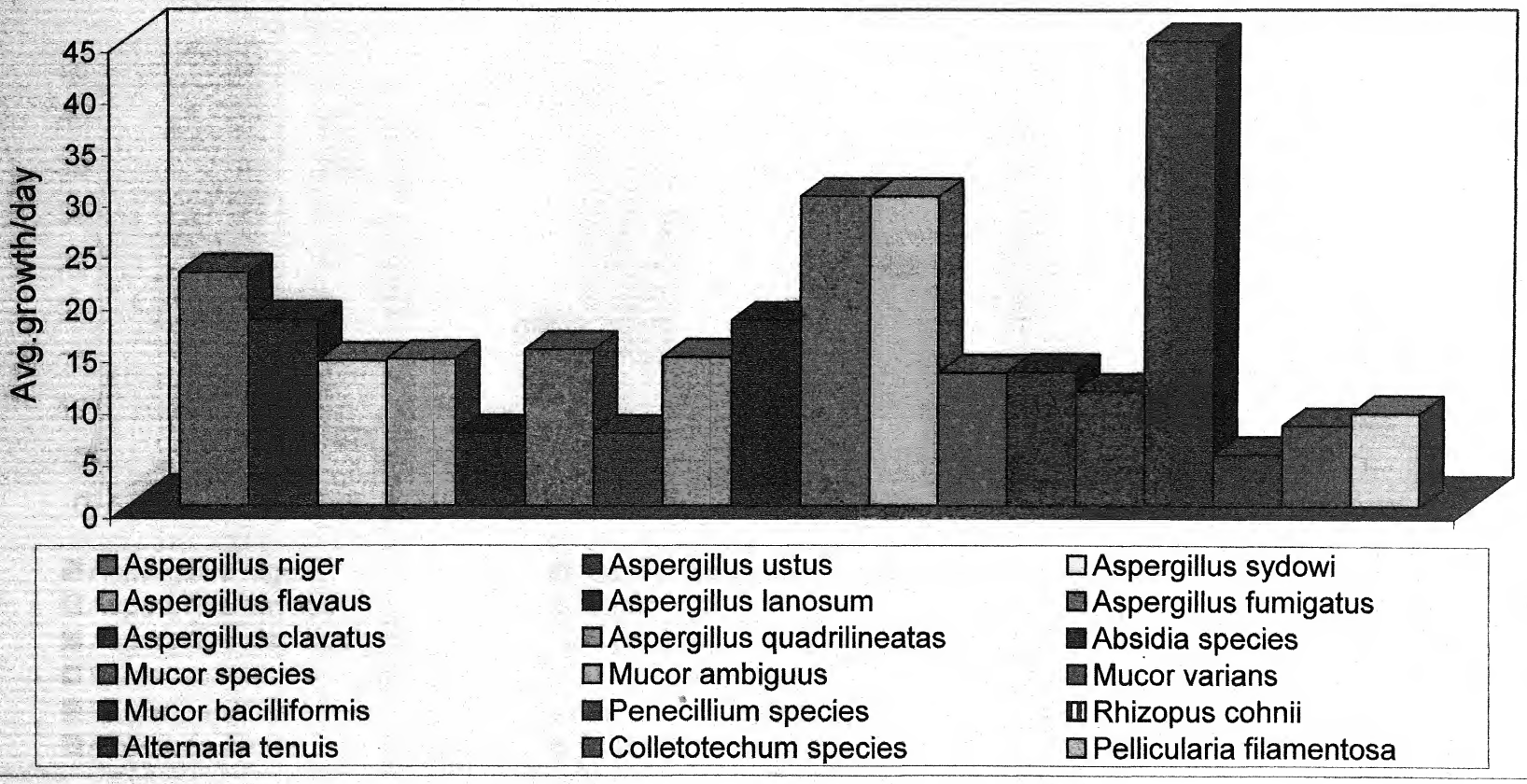


Fig. LVI (C) Test for antifungal activity of Lantana camera plant water extract

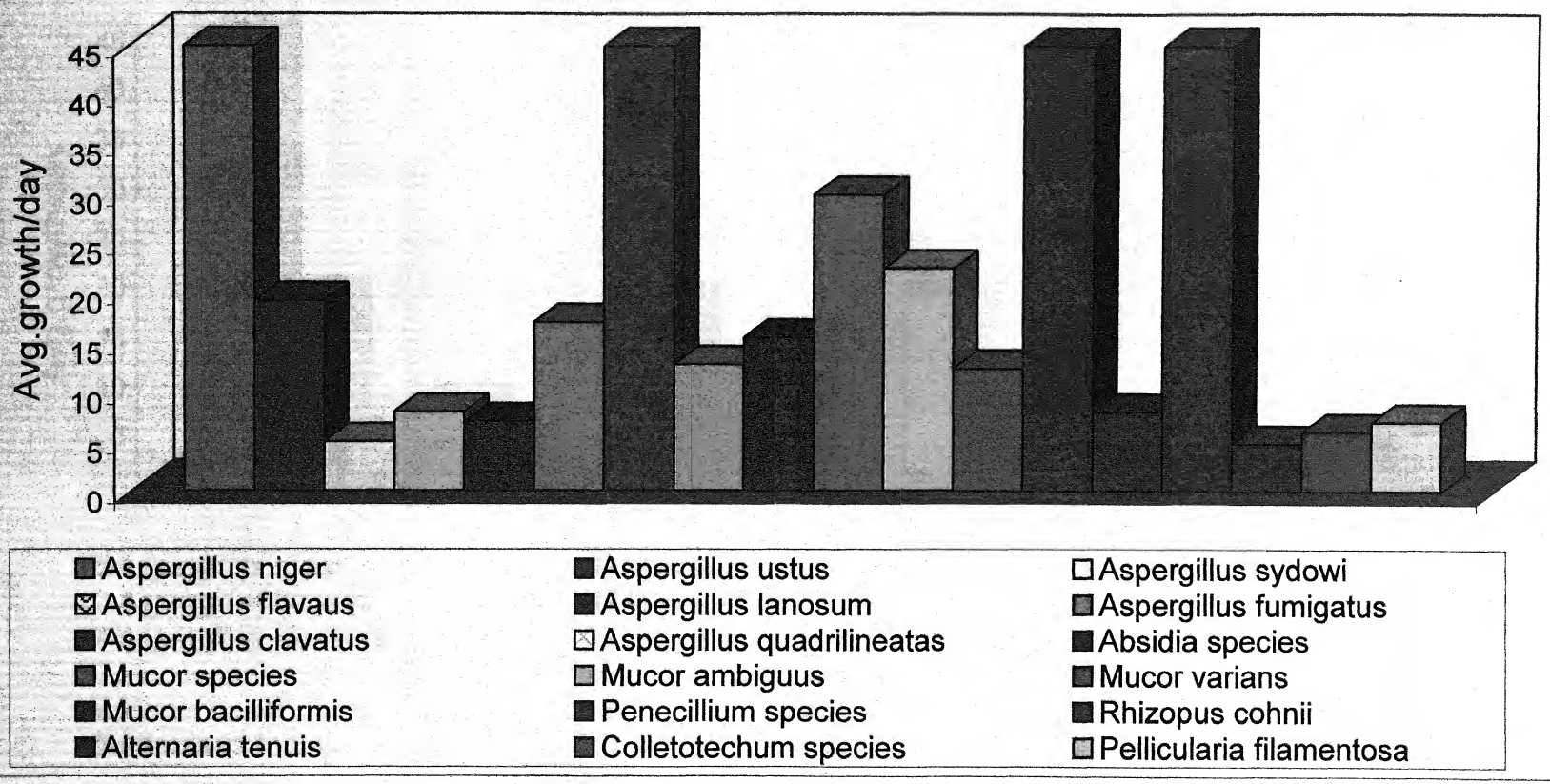


Fig. LVI (D) Test for antifungal activity of Azadirachta indica plant water extract

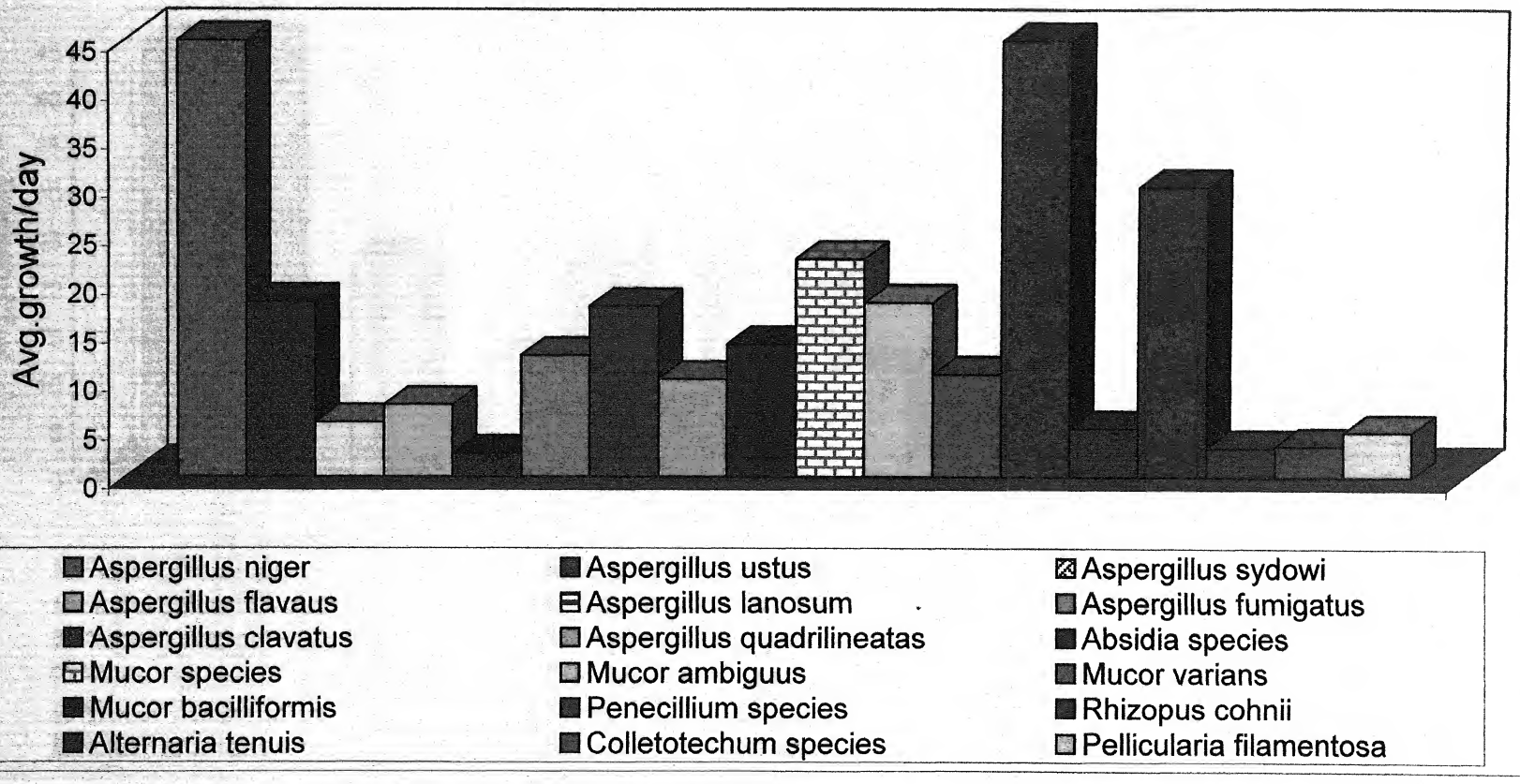


Fig. LVI (E) Test for antifungal activity of Ageratum conyzoides plant water extract

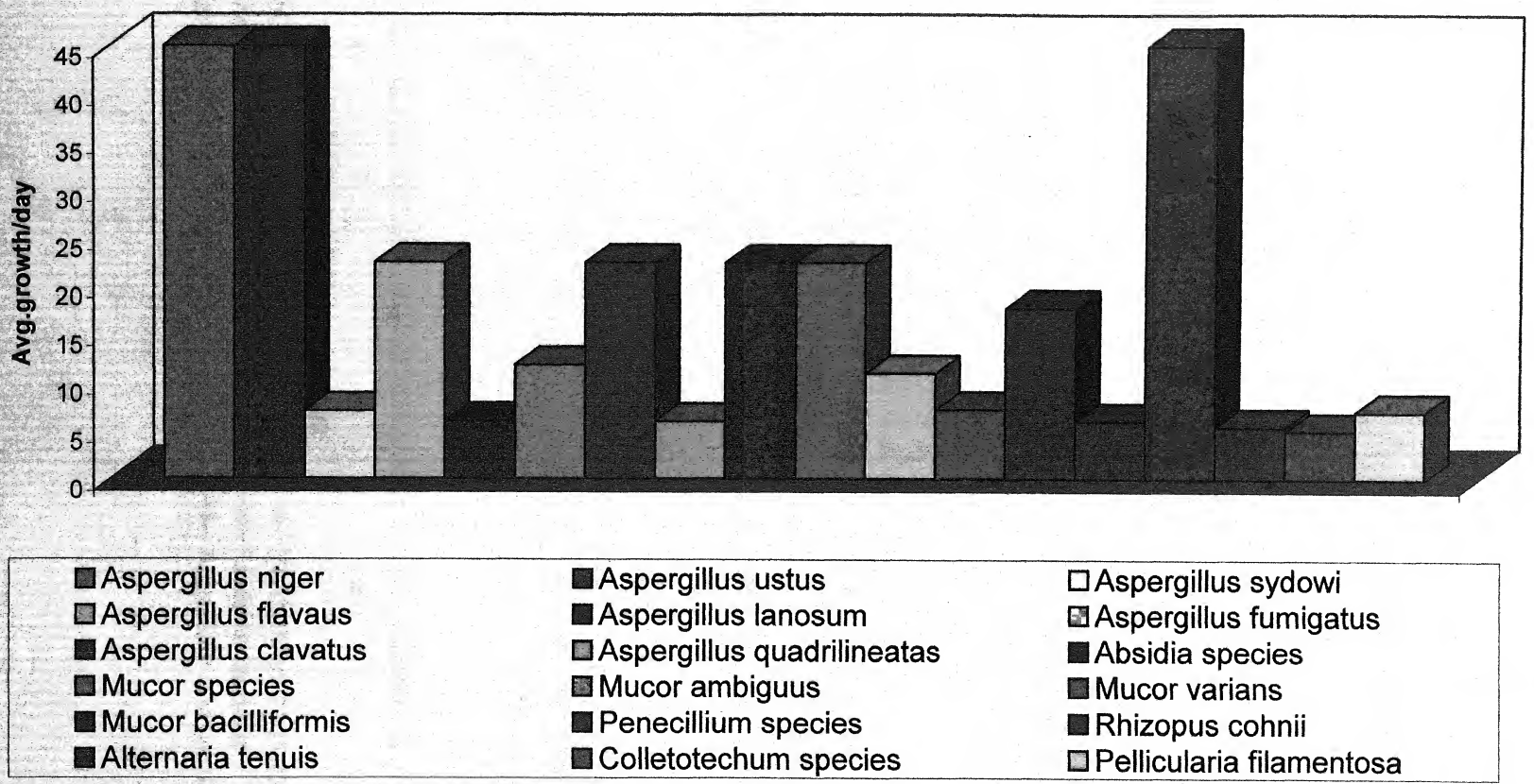


Fig. LVI (F) Affect on radial growth of Aspergillus niger in presence of plant extract

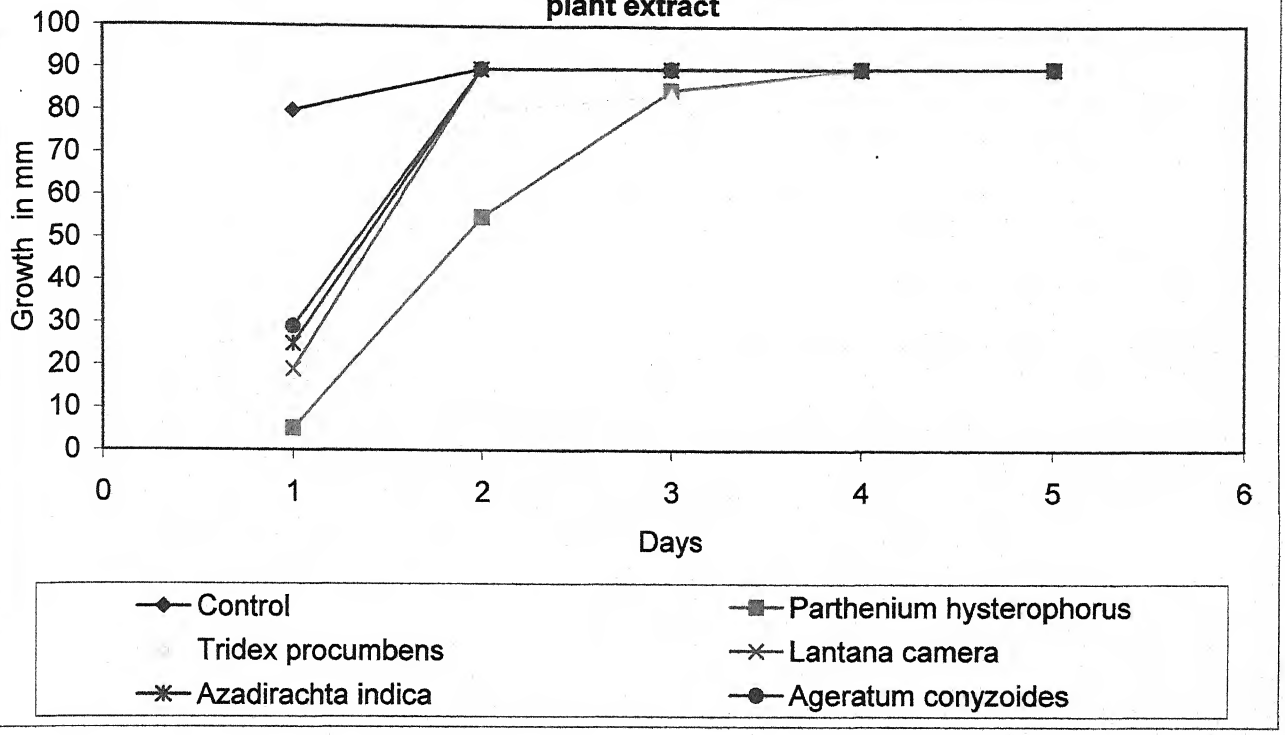


Fig. LVI (G) Affect on radial growth of Aspergillus ustus in presence of plant extract

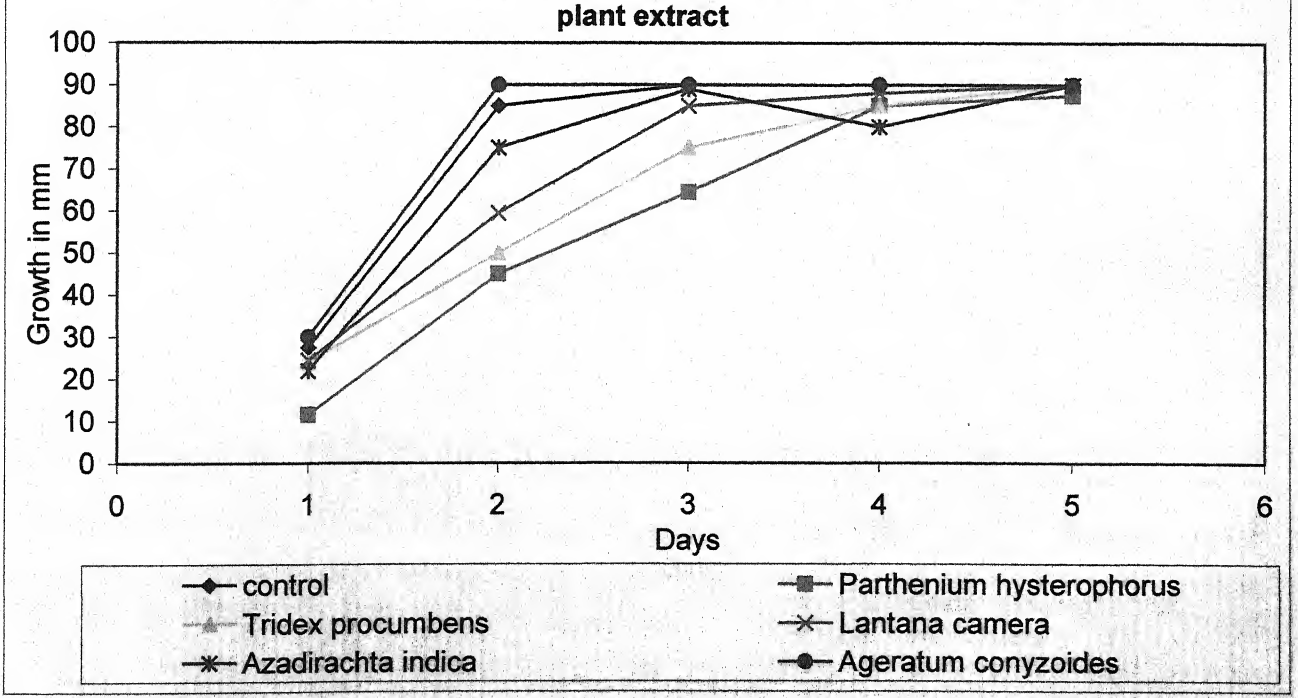


Fig. LVI (H) Affect on radial growth of Aspergillus sydowi in presence of plant extract

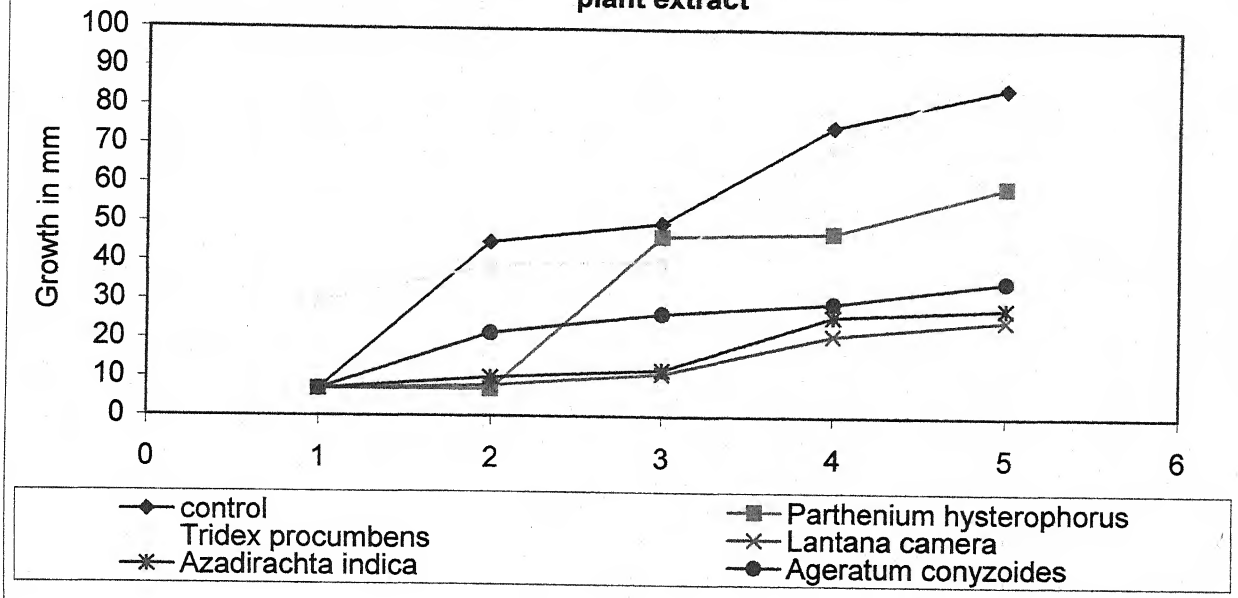


Fig. LVI (I) Affect on radial growth of Aspergillus flavaus in presence of plant extract

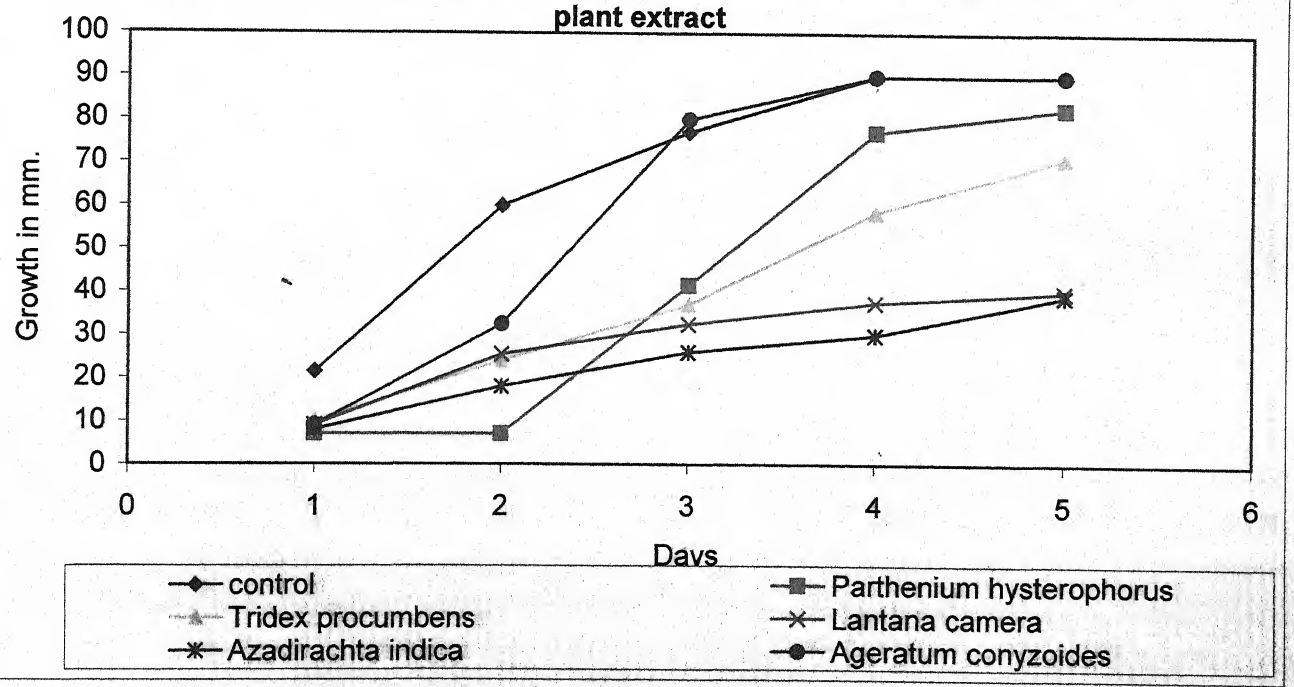


Fig. LVI (J) Affect on radial growth of Aspergillus lanosum in presence of plant extract

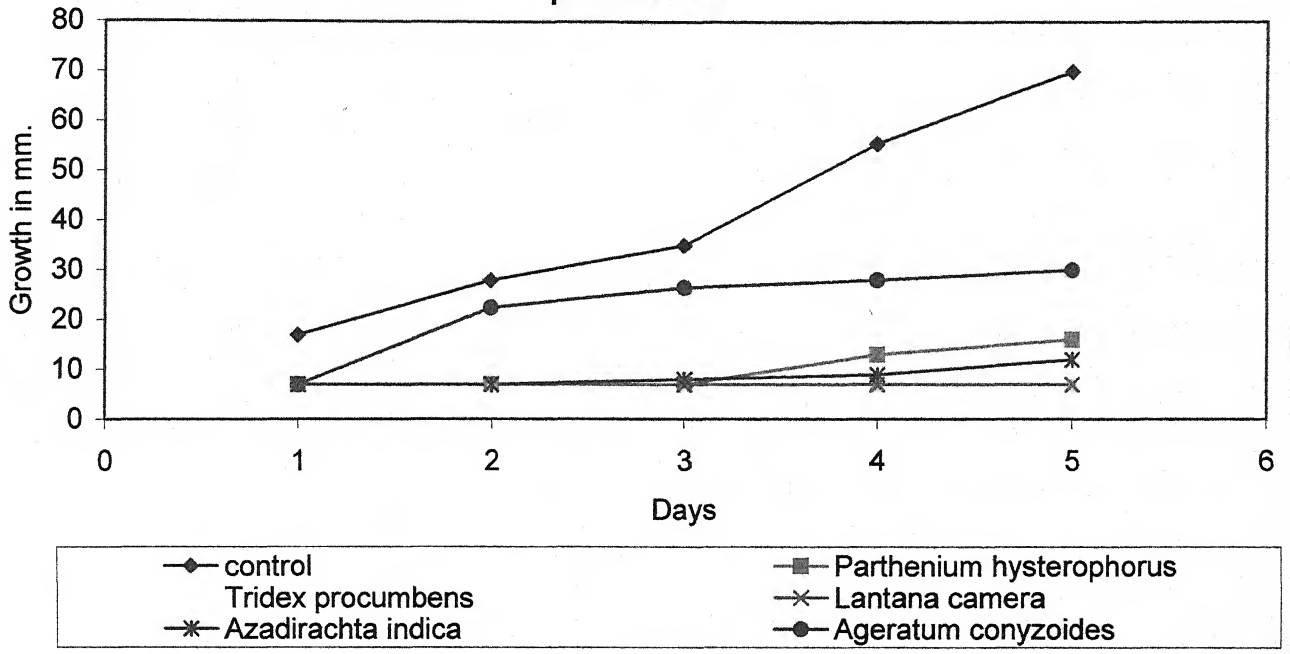


Fig. LVI (K) Affect on radial growth of Aspergillus fumigatus in presence of plant extract

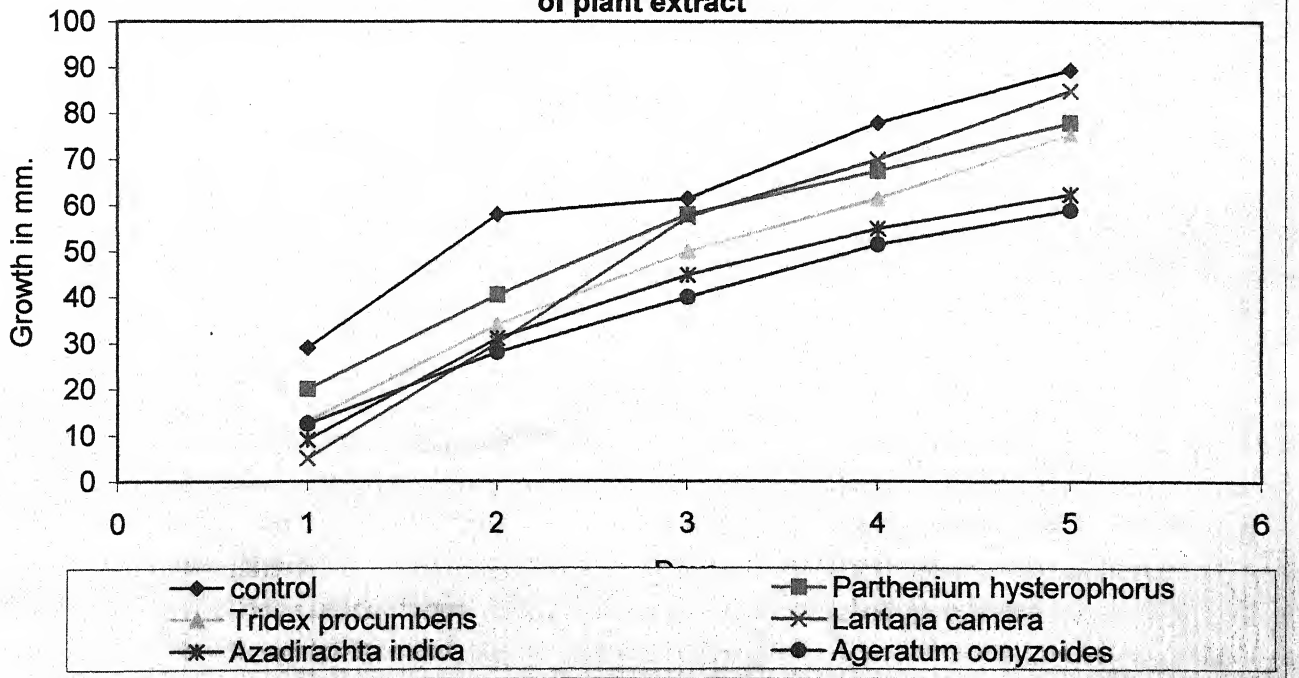


Fig. LVI (L) Affect on radial growth of Aspergillus clavatus in presence of plant extract

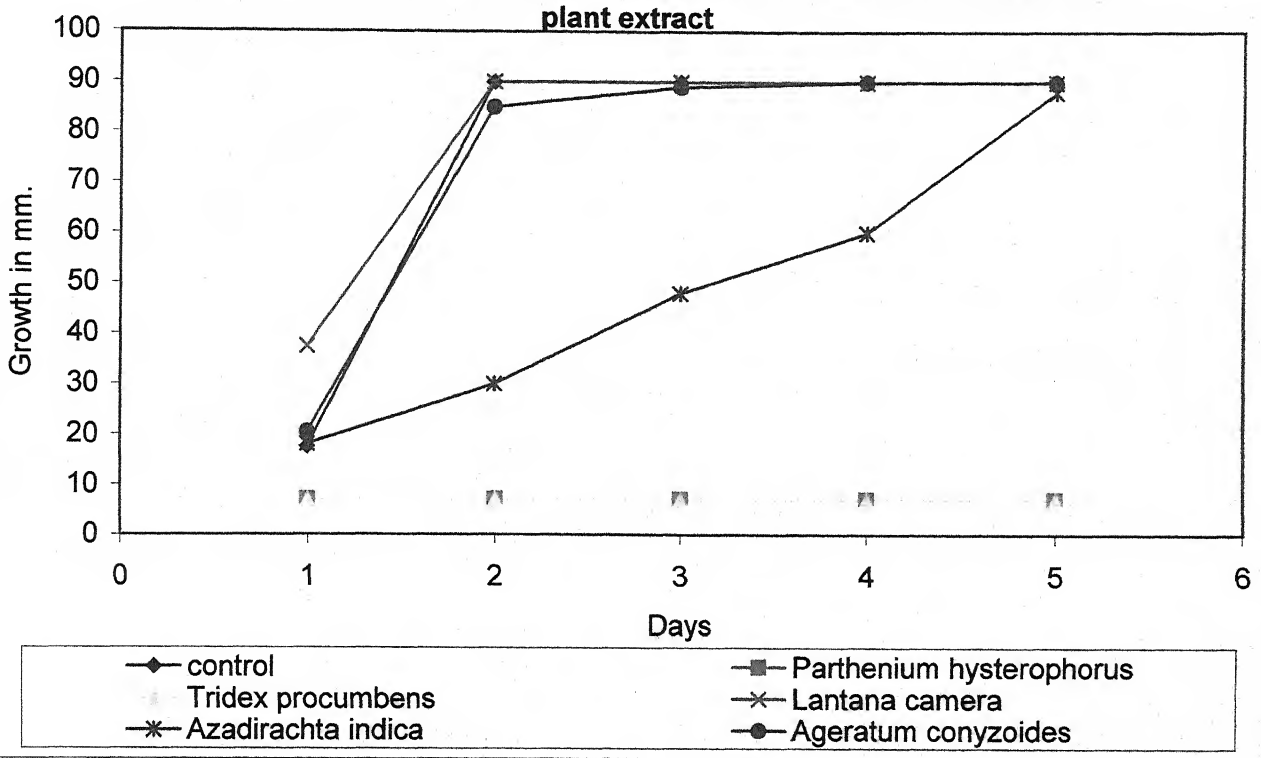


Fig. LVI (M) Affect on radial growth of Aspergillus quadrilineatas in presence of plant extract

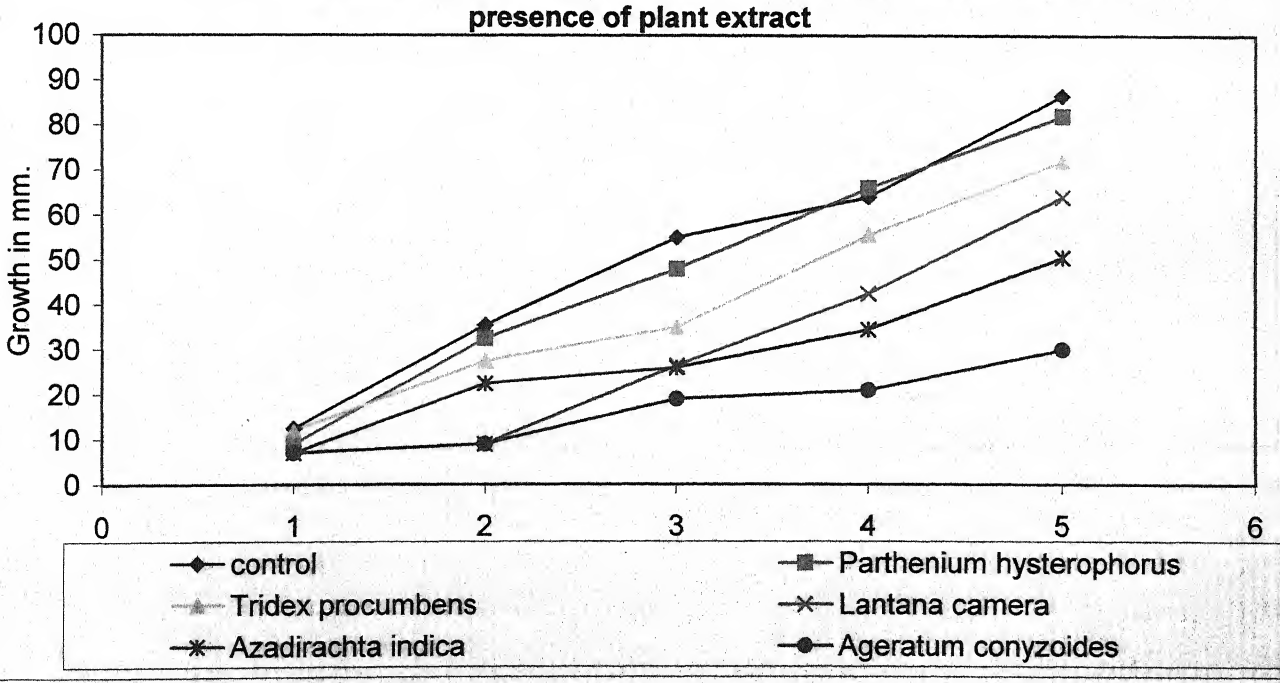


Fig. LVI (N) Affect on radial growth of Absidia species in presence of plant extract

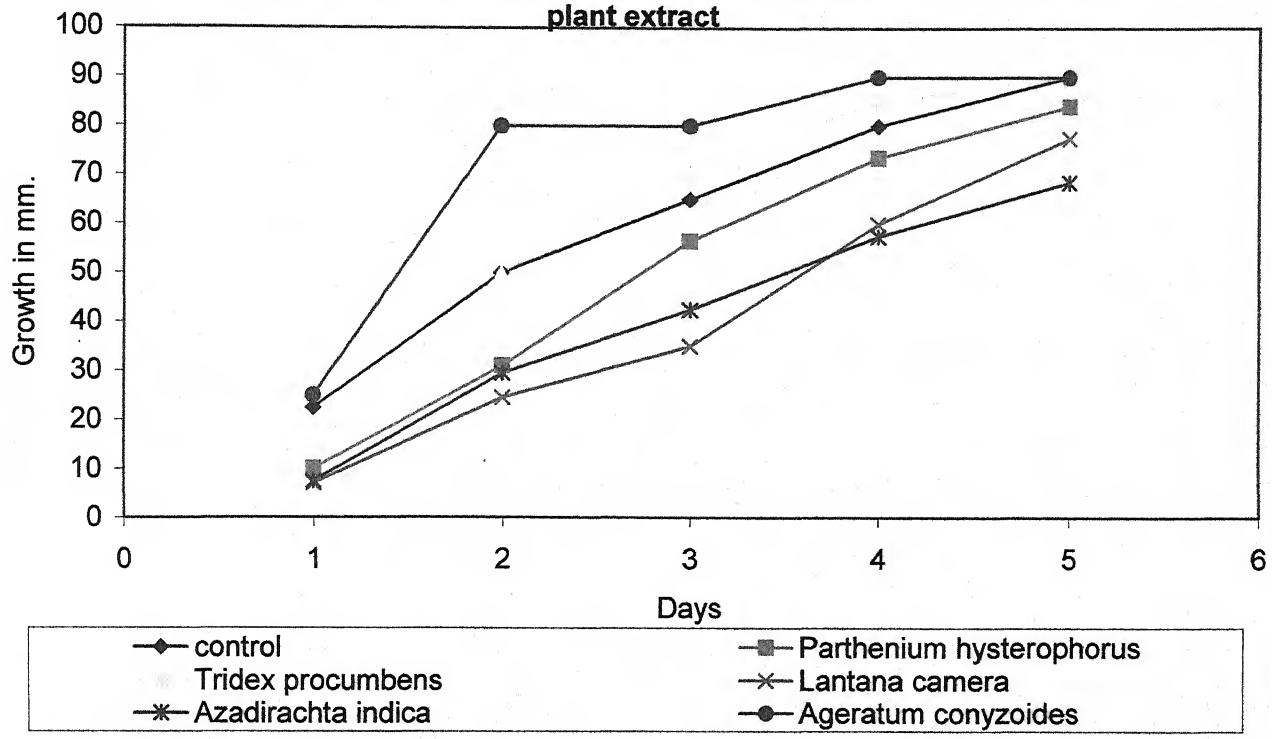


Fig. LVI (O) Affect on radial growth of Mucor species in presence of plant extract

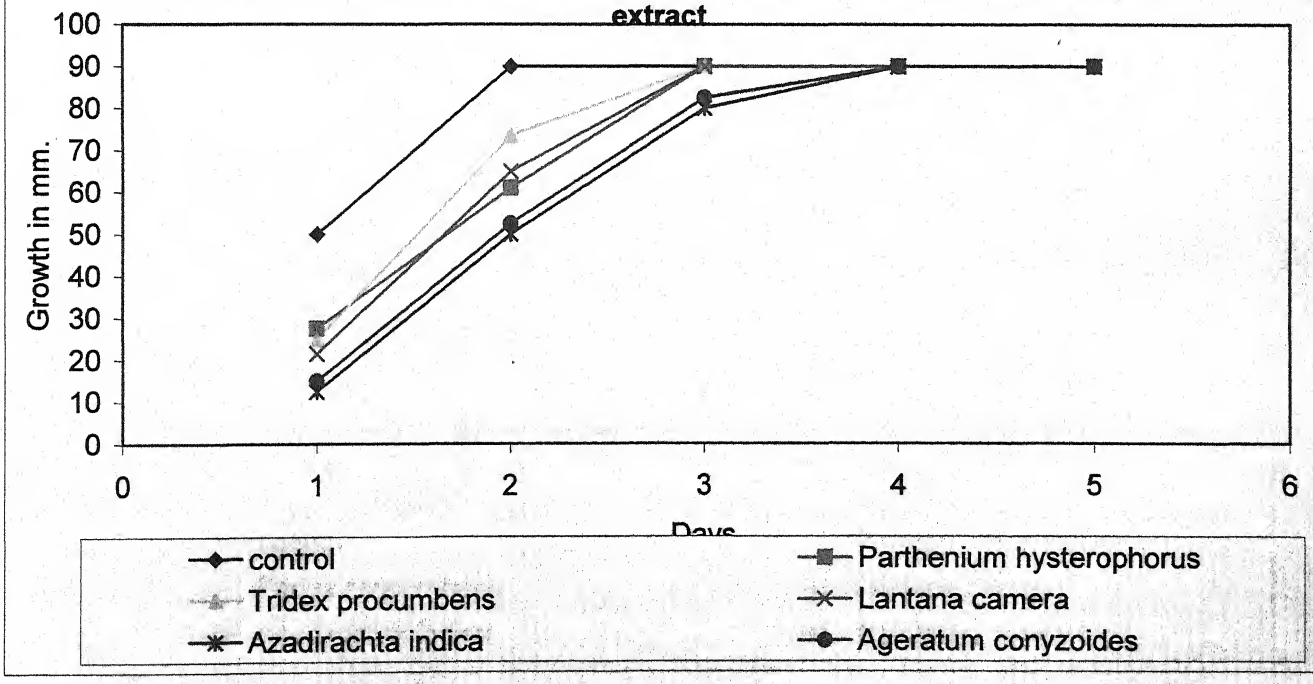


Fig. LVI (P) Affect on radial growth of Mucor ambiguus in presence of plant extract

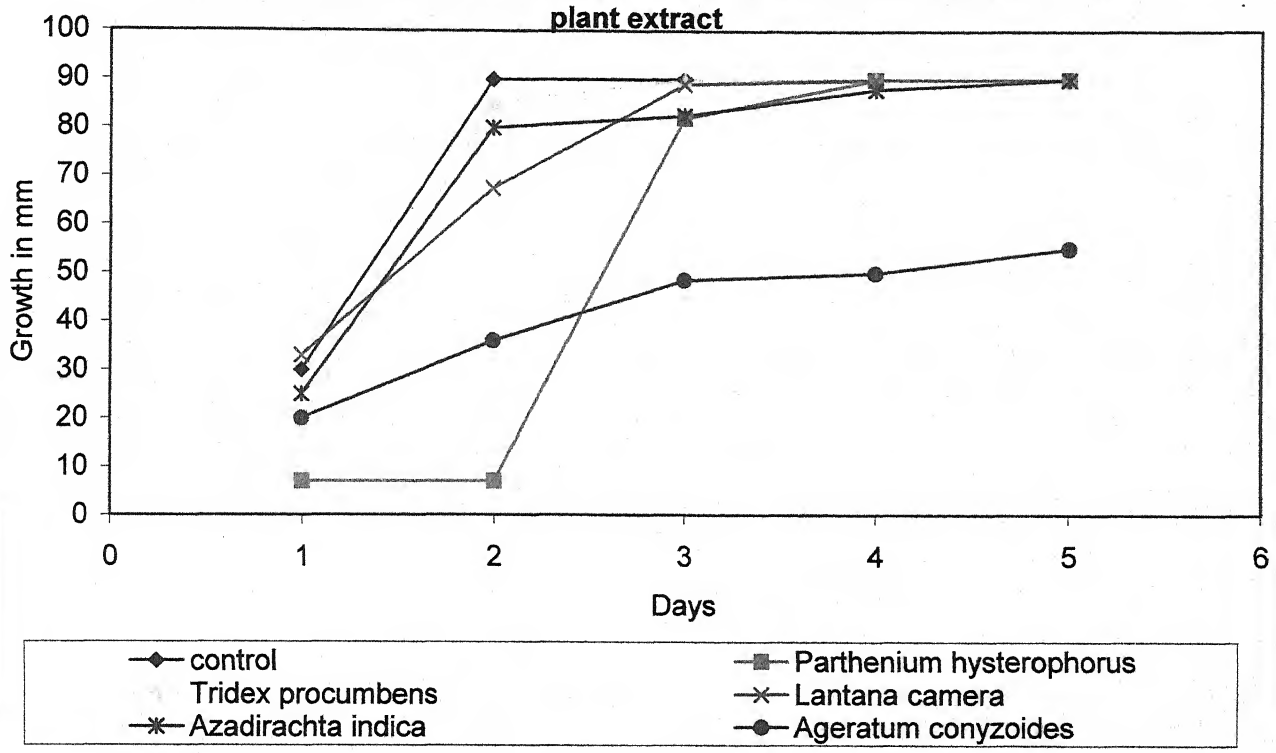


Fig. LVI (Q) Affect on radial growth of Mucor varians in presence of plant extract

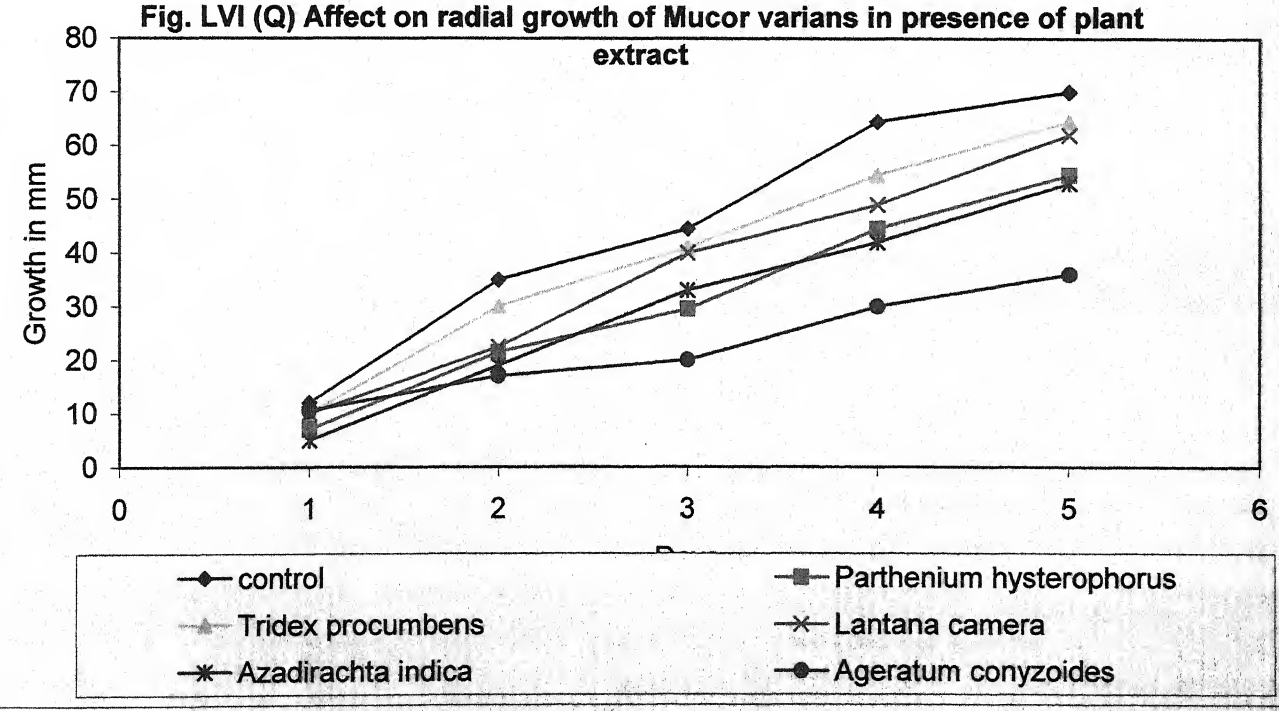


Fig. LVI (R) Affect on radial growth of Mucor bacilliformis in presence of plant extract

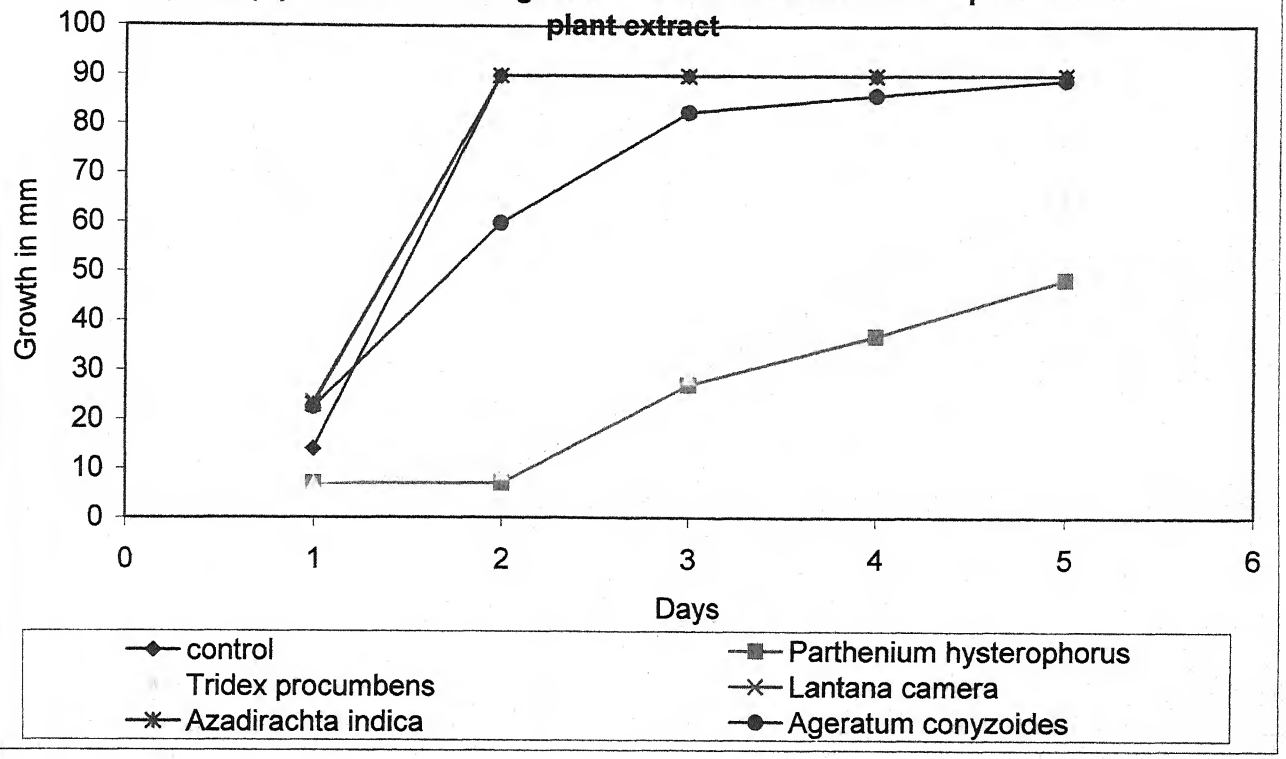


Fig. LVI (S) Affect on radial growth of Pencecillium species in presence of plant extract

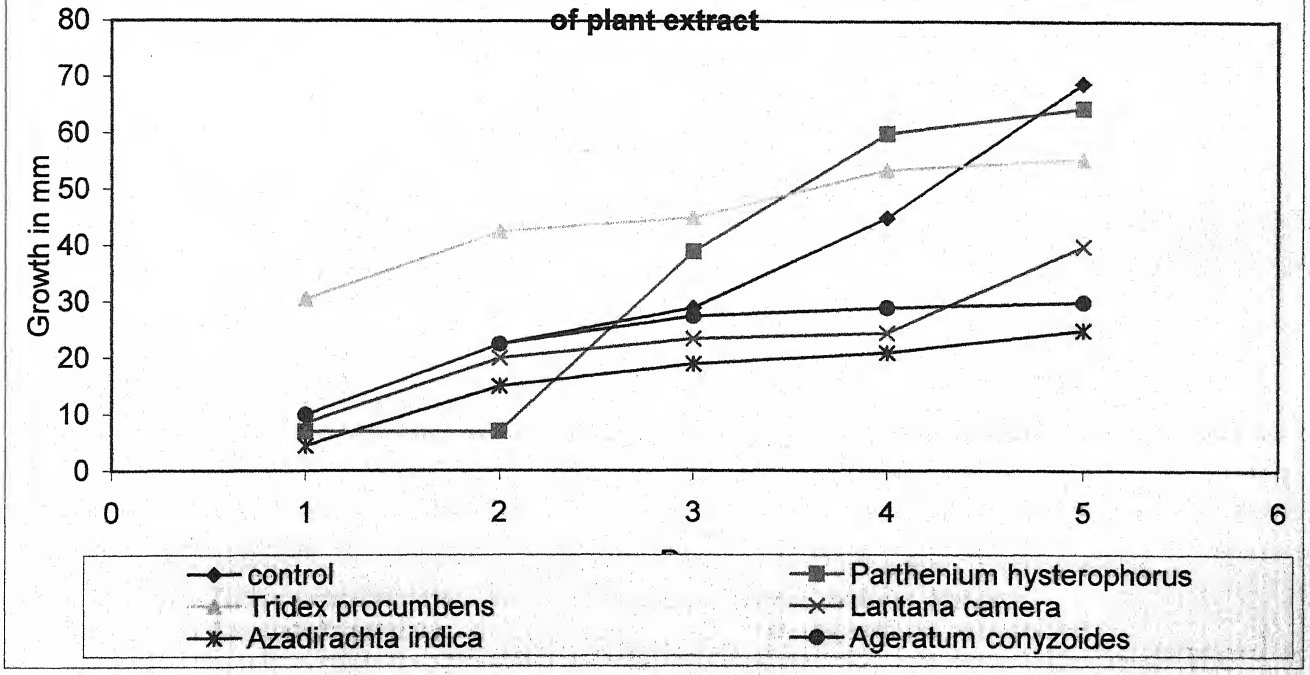


Fig. LVI (T) Affect on radial growth of Rhizopus cohnii in presence of plant extract

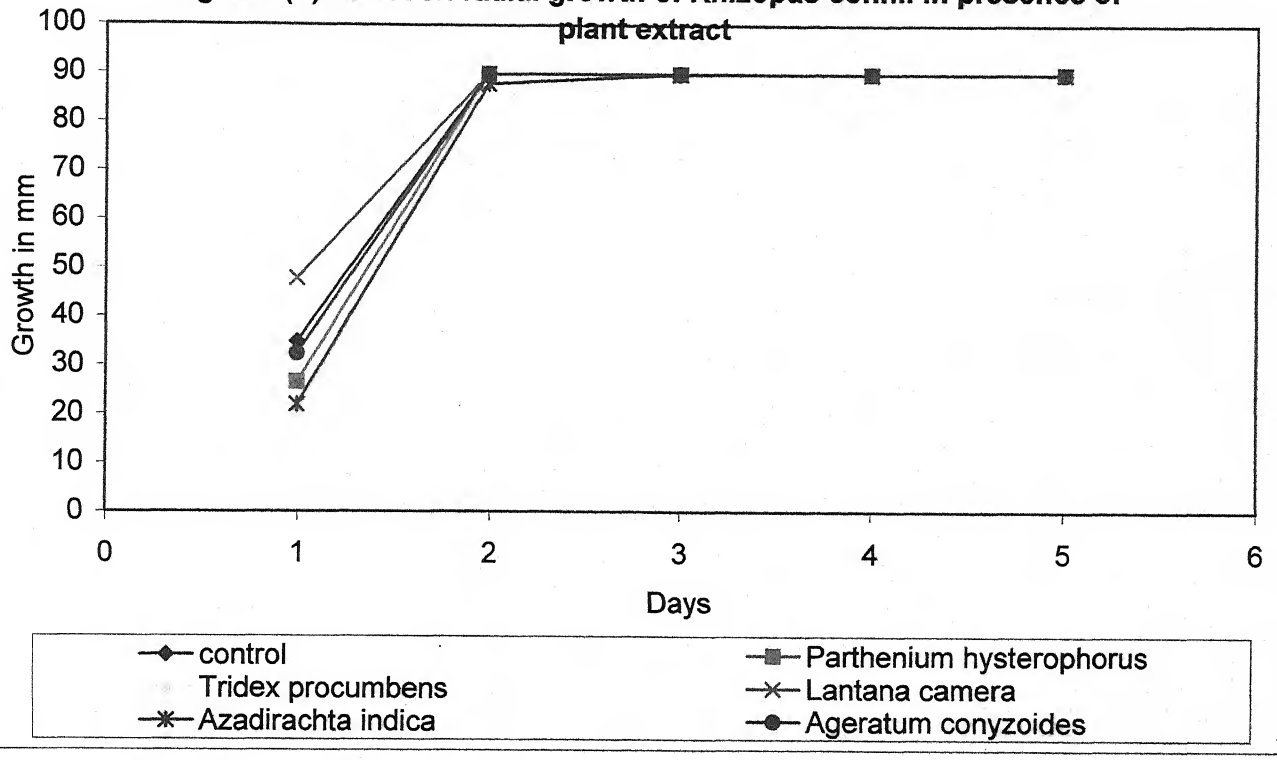


Fig. LVI (U) Affect on radial growth of Alternariatenuis in presence of plant extract

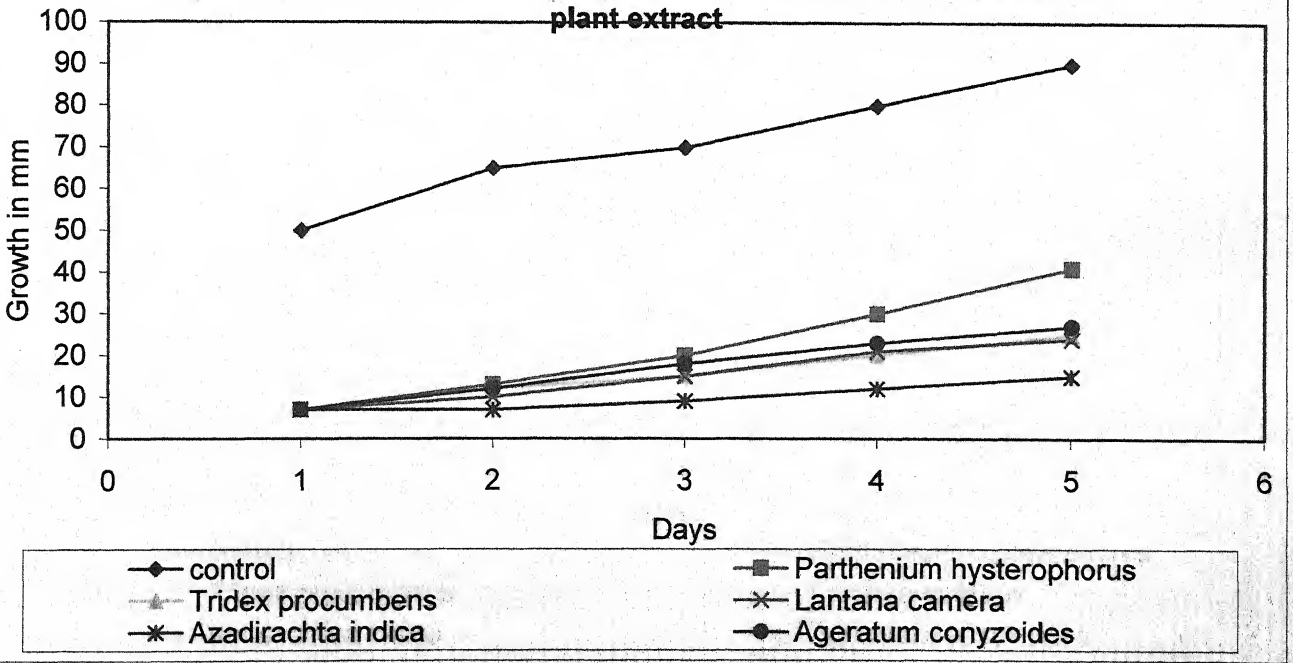


Fig. LVI (V) Affect on radial growth of Colletotrichum species in presence of plant extract

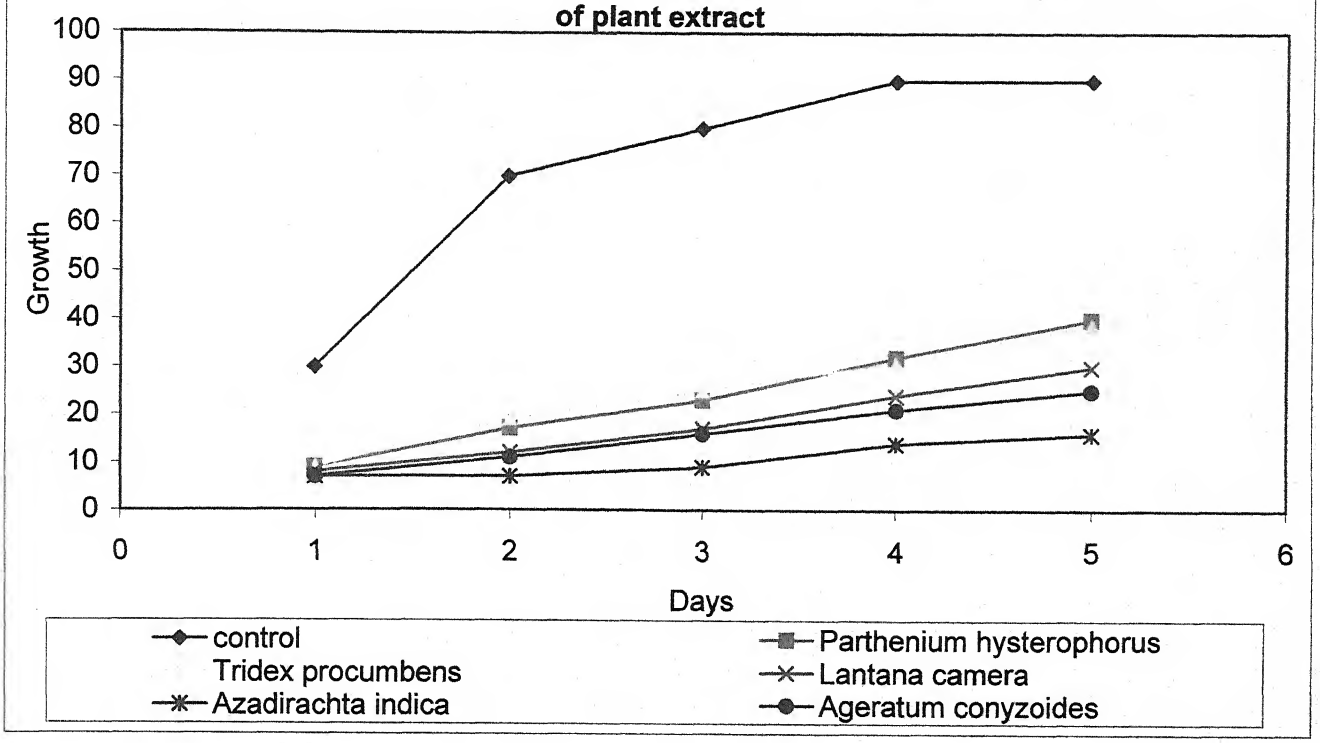
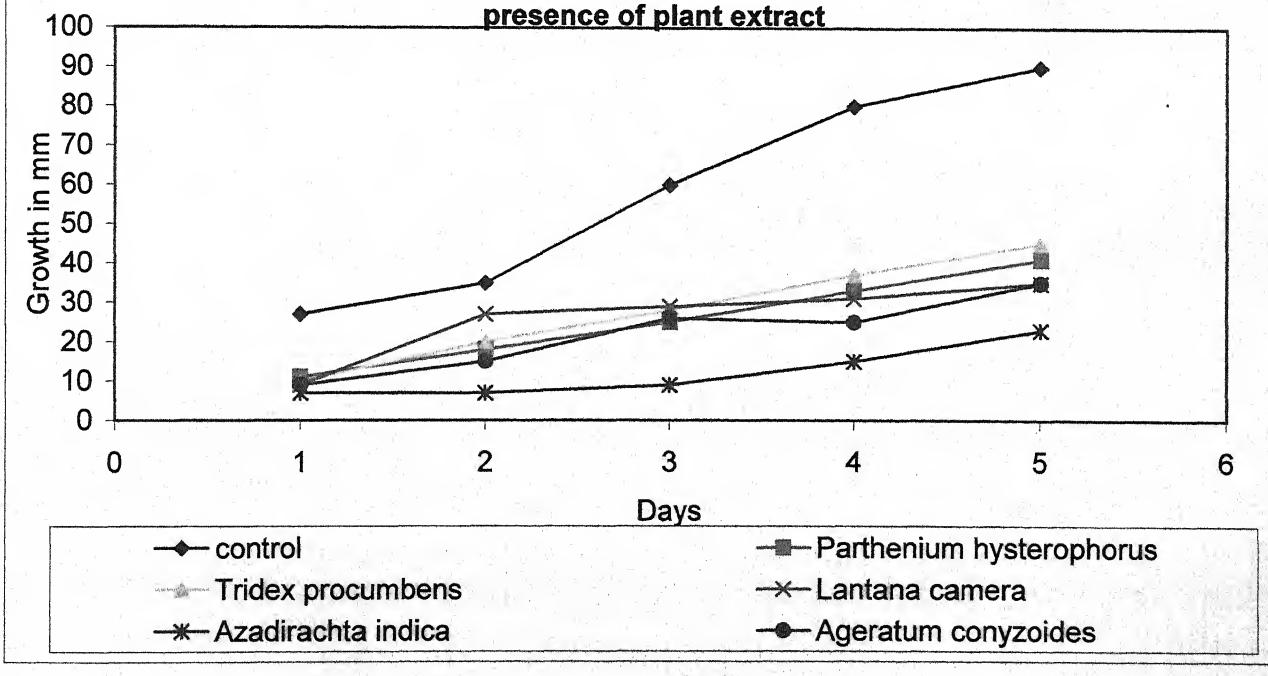


Fig. LVI (W) Affect on radial growth of Pellicularia filamentosa in presence of plant extract



SECTION 5

SUMMARY AND DISCUSSION

SUMMARY AND DISCUSSION

For a highly populated country like India, crop yield in though important but more importance should be given to the methods of storage. The post harvest loss is estimated to be 50% in developing country (Ahmed and Grainge 1986). During storage, insect pest control is very important for which generally chemicals are used. These chemicals in addition to causing biomagnification and ecological imbalance also develop harmful effects on man and animals. In order to get an ecofriendly alternative substance, vegetational wealth was screened with a view to get most easily available, cheepers biodegradable antifeedant substance. Is this region seeds of Urd, Mung, White gram, Black gram and Lentil are widely damage by insect pest Callosobruchus chinensis during storage. Work conducted during the present study is being summarised and discussed below-

Collection Of Plant Materials :-

In order to get antifeedant biodegradable plant materials, plants were collected belonging to 20 different angiospermic species. These were identified through monographs and herbarium specimen of the department and then were dried under shade at room temperature for more than a month till constant weight was achieved. The plant material was than reduced to powdered from of 40 to 60 mesh size and stored in clean dry place. These were placed in a screw capped plastic bottles for primilinary screen and isolation of extracts and essential oils.

Preparation of water and solvent extracts :-

Water extracts were prepared from the plant materials, which gave positive antifeedant activity during preliminary screening, for this powdered materials were kept on a magnetic stirrier with 500 ml distilled water for 30 minutes. These were filtered through the whatman filter paper to obtain water extracts. These extracts varied from light green to gray in colour. Solvent extracts were obtained in acetone, petroleum ether and methanol, both with out heating that is cold extracts and with heat that is hot solvent extract. Cold solvent extracts were prepared on magnetic stirrer, while hot solvent extracts were prepared in soxhlet apparatus. Their yield has been shown in the table I and II respectively. Tridex procumbens, Ageratum conyzoides and Parthenium hysterophorus followed by acetone and petroleum ether, while Lantana camera and Azadirachta indica gave better yield in acetone. Similar results were obtained in hot solvent but as compared to cold solvent extract yield was better in hot solvent extract. This show that the plant materials have better solubility under heating. The soluble behaviour of the plant were similar in both the conditions though higher solubility under heat.

Extraction of Essential Oils :-

For this Perkins apparatus were used and the extraction was done after saturation with sodium chloride, by using petroleum ether. Petroleum ether was evaporated and the yield of essential oil so obtained have been shown in the table III. Highest yield was obtained from Azadirachta indica followed by Ageratum conyzoides, Tridex procumbens and Lantana camera respectively. No oil was found in Parthenium hysterophorus, it appears that this plant does not contain sufficient essential oil which could be obtained.

Lab Culture of Callosobruchus chinensis :-

Lab culture were raised in the cereals of Phaseolus mungo, Phaseolus radiatus, Lens esculenta, Cicer areitinum and Cicer kabulicum. Rearing was conducted in glassvials from healthy insects of Callosobruchus chinensis collected from the infested seeds of the local market. These vials were kept in insect rearing laboratory cabinet maintain at 27 ± 2 ^{0}C with 75 ± 10% relative humidity and 14:10 L.D. Photoperiod. During the rearing stages under natural conditions, it was observed that maximum population increased during August and September followed by moderate population during November and December, while least during the summer season. This observations is in comformity with that of Rajak and Pandey 1965; Sinha and Prasad 1988. It appeared that temperature and humidity are the determining factor which modified the cereals nature according to the liking of the insect.

Preliminary screening from various powdered materials against Callosobruchus chinensis :-

Protectant activity of 20 angiospermic plants were tested against Callosobruchus chinensis separately with Phaseolus mungo, Phaseolus radiatus, Cicer kabulicum, Lens esculenta and Cicer areitinum cereals. Their mortality observed after 2 months have been shown in the table IV. Among these plants 5 angiospermic plants which gave best antifeedant activity were selected for further study. These were Ageratum conyzoides, Azadirachta indica, Lantana camera, Parthenium hysterophorus and Tridex procumbens. Deshpande 1967, found neem as seed protectant; Gupta et. al., 1994, found insecticidal activity of Ageratum conyzoides; Pradhan et. al., 1962, found mung seed deterrant to locust. Rao et. al., 1995, controlled root knot nematode and tomato by neem cake; Roomi and Ariquiddin 1977, from Pakistan observed repellent activity of neem on stored grain pest; Meshram et. al.,

1997, found antifeedant activity of Lantana camera against the larvae of teak defoliator, Hyblaca pueracram; Saxena et. al., 1992, found Lantana camera insecticidal against Callosobruchus chinensis; Warthen 1979, through a review article described Azadirachta indica as a source of insect inhibitors. None of these workers have analysed the protectant activity of these plants on different cereals. The author wanted to get a common antifeedant plant material, which could be used for all cereals.

Protectant activity of selected powders plant materials :-

After obtaining significant activity during 2 months of storage the protectant activity was observed after 4,8 and 12 months duration. The datas obtained have been recorded in terms of percentage protection and percentage mortality in the tables V to XIV. The effect of 2,4 and 5 gms. powdered material was observed in 50 gms. of each cereals. From these observations it was observed that the percentage protection was best when used in 5 gm. quantity. From the results it is clear that none of the plant powders could protect all the cereals. Their results varied from one cereals to the other.

Cicer kabulicum was 100% protected upto 8 months by the powders of Azadirachta indica and Parthenium hysterophous. Phaseolus radiatus was 100% protected upto the same period by Azadirachta indica and Tridex procumbens. Lens esculenta was 100% protected by Azadirachta indica, Parthenium hysterophorus and Ageratum conyzoides. Cicer areitinum was 100% protected by Lantana camera and Parthenium hysterophorus while Phaseolus mungo was 100% protected by Lantana camera. The percentage protection slightly reduced after 8 months upto 12 months. Azadirachta indica and Parthenium hysterophorus protected well the seeds of 3 cereals while Lantana camera protected 2 cereals and Tridex procumbens and Ageratum conyzoides, one cereals each.

These results are in comfirmity to the observations of Pandey et. al., 1976 who used some plant powders as protectant against Callosobruchus chinensis; Girish and Jain 1974 studied the efficacy of neem kernel powder against stored grain pest, while Jotwani and Sircar 1965 found neem seed as protectant against stored grain pests, Singh et. al.,, 1993 found neem dust as protectant for stored grain pest same protectant activity of Azadirachta indica has been observed on Cicer kabulicum, Phaseolus radiatus and Lens esculenta by using neem leaves powder. Percentage mortality of Callosobruchus chinensis have been recorded in the table X to XVII. From datas in table XIV it was observed that the mortality rate increased gradually from 4 to 8 and than 12 months duration, from these results it appears that these plant powders have a protective role. Much more as compared to the irradication of a insect pest. They are true repellents, feeding deterrents or retardant which are aimed to prevent the food grain rather than to kill the insect. The increased in the mortality up to 12 months show that these compounds do not kill the insect immediately. Gupta et. al., 1994 has observed insecticidal activity of Ageratum conyzoides against Callosobruchus chinensis. Saxena et. al., 1992 found insecticidal action of Lantana camera against Callosobruchus chinensis. Similar insecticidal active has been shown by the author from these plant powders.

Protectant activity from composite samples of selected plants powders :-

This experiment was done with a view to developed plant powdered material, which could be equally effective for all the cereals. This experiment was conducted in 2 steps. In one all the 5 plant powder were mixed up in equal proportion to prepare composite sample and then percentage protection and percentage mortality was observed after 10 days and 1 month. As indicated in the table XV the percentage protection for Cicer

kabulicum, Phaseolus mungo and Phaseolus radiatus was 100% upto one month but in Lens esculenta and Cicer areitinum100% protection was found up to 10 days which after one month were reduced to 99.9% and 99% respectively. Percentage mortality as recorded in the table XVI indicate that in Cicer kabulicum, Phaseolus mungo and Phaseolus radiatus there was 100% mortality of Callosobruchus chinensis, after 10 days and one month durations but Lens esculenta, Cicer areitinum showed 80% mortality after 10 days, 100% after one months. This again showed that these substances are repellents, feeding deterrent or retardant rather than insecticidal.

In the next step 3 plant powders which gave better protectant activity were mixed to form composite samples and percentage protection and percentage mortality was observed after 10 days. For this powders of Azardirchta indica, Lantana camera and Parthenium hysterophorus were mixed. The datas obtained has been given in the table XVII. As is evident from the data obtained that this composite sample gave 100% mortality and 100% protection for all the cereals after 10 days. This sample proved to be better antifeedant as compared to those composite sample where 5 plants powders were mixed. No such workers on composite sample has been done by other workers and therefor could not be compared from the results of ther workers it appears that composite sample of these 3 plants could be recommended to protect any of these cereals during storage.

Protectant activity of seleted plants distilled water extracts :-

Distilled water extracts were obtained from Azadirachta indica, Parthenium hysterophorus, Ageratum conyzoides, Tridex procumbens and Lantana camera. After ½ an hours treatment on magnetic stirrer percentage protection and percentage mortality was obtained after 10 days when used in 1%, 2% and 3% concentration. The datas obtained has been given in the table XVIII upto XXVII. Form the data obtained it can be observed that the best

results were found, when the extract were used in 3% concentration. In the distilled water extract Azadirachta indica the best activity of 100% mortalty and percentage protection was observed in its 3% concentration for Lens esculenta and Cicer areitinum. This was followed by Phaseolus mungo, Cicer kabulicum and Phaseolus radiatus. In Parthenium hysterophorus plant extract, protectant activity were best for Cicer kabulicum, Lens esculenta and Cicer areitinum where percentage mortality was 100% in Cicer kabulicum and Cicer areitinum. This was followed by Lens esculenta, Phaseolus radiatus and Phaseolus mungo. In 3% concentration of the extract when Ageratum conyzoides, plant water extract was used percentage mortality and percentage protection was best in the seeds of Lens esculenta. It showed 100% mortality and 99.27% protection. In Tridex procumbens distilled watre extract Phaseolus mungo and Lens esculenta, showed best plant protection however the percentage mortality the best Phaseolus radiatus and Cicer areitinum. However Phaseolus radiatus also showed very good percentage protection only less than.1% of the two cereals Lantana camera plant distilled water extract showed 100% mortality. In Phaseolus mungo and Cicer areitinum, the percentage protection was 99.18% and 99.28% respectively for the 2 cereals. The results obtained in general confirm the protectant activity recorded with the powder for these antifeedant plants. These results of the authors are incorrelation with the results obtained by Boby 1996; Dixit et. al., 1991; Gupta 1996. and Pandey 1986.

Protectant activity of selected plants cold solvent extracts :- Cold solvent extracts were obtained in acetone, petroleum ether and methanol in 1%,.5% and.25% concentrations on magnetic shaker the datas obtained for percentage protection and percentage mortality has shown in the table XXVIII to XXXVII after 4,8,12 and 16 days. The datas obtained showed better results in 1% concentration as compared to the other concentrations. In Azadirachta indica cold solvent extract 100% protection was obtained up to 16 days in 1%

concentration for all the cereals with all the solvents. Even in.5% and.25% concentration nearly 100% protection was noted upto 12 days. There after there was negligible decline after 16 days. Similarly 100% mortality was obtained in 1% concentration for all the days of observation for all cereals in all solvents. In.5% concentration acetone extracts gave 100% mortality for Callosobruchus chinensis. Even in.25% concentration significant results were obtained in the cold solvent of acetone extracts. This solvent extract appearance to be better in providing antifeedant activity as compared to other solvents. For Azadirachta indica, Parthenium hysterophous. Cold extract also gave good protectant activity for all the cereals in 1% concentration in all the solvents. Where almost 100% protection was obtained in.5% and.25% concentrations. However with the increase in the days, the percentage protection slightly decline but this decline was almost negligible. The percentage mortality of Callosobruchus chinensis was 100% in 1% concentration, when used in Cicer kabulicum, Lens esculenta and Cicer areitinum in all the 3 solvent. In.5% and.25% concentration, the percentage mortality gradually increased. This show that in lower concentration, these antifeedant substance served as feeding deterrents and do not kill the insect immediately the grow in no, which increased the percentage mortality immediately. Best results were observed in acetone extract for Cicer kabulicum, Lens esculenta and Cicer areitinum. Where 100% mortality was observed in.5% concentration after 16 days. Tridex procumbens cold extract was found to be quite effective in protecting the cereals, all the 3 solvents extract were found to be allmost equally effective, 100% protection was found in 1% concentration and even.5% and.25% concentration. The protection was not less than 99.15%. The percentage mortality was best in acetone extract as compare to the other solvent extract. 1% concentration gave best results followed by.5% and.25% concentration. All the 3 solvent cold extract of Lantana camea were found to be equally effective in protecting the cereals

against Callosobruchus chinensis. Its 1% concentration gave 100% protection.5% and.25% concentration also the percentage protection was 100% or nearly 100% during all the days of observations. In Lantana camera cold solvent extract 100% mortality was observed in 1% concentration of all the 3 solvents. Its methanol extract was found to be better as compared to other solvents its activity was 2nd most effective and only next to Azadirachta indica. Ageratum conyzoides cold extract appears to be least effective, although above 99% protection was obtained in all the 3 dilutions. Its petroleum ether and methanol extract was found to be better as compare to acetone extract. The activity of solvent extract from antifeedant plant in general were found to be more effective as compare to the aqueous extracts they could be more effective for longer durations if used in higher concentrations.

Protectant activity of hot solvent extracts :-

Extract obtained through soxhlet apparatus has been called in the text as hot solvent extract and the antifeedant activity interms of percentage protection and percentage mortality for 4,8, 12 and 16 days has been shown in the table XXXVIII to XXXXVII. The data obtained from these table show that Azadirachta indica hot solvent extract gave almost similar results in all the 3 solvents. Its percentage protection was 100% upto 16 days in 1% concentration, up to 8 days in.5% concentration and even in.25% concentration gave significant results, and percentage protection with increase in the days did not show much decline in the percentage. Percentage mortality was also 100% in 1% concentration. In.5% and.25% concentration the percentage mortality gradually increase with increase in duration which show that the extract was not much lethal and more protectant than irradicant. Acetone extract was found to be better as compare to other solvent. Hot solvent extract gave better results as compare to the cold solvent extract

Lantana camera hot solvent extract gave 100% protection in 1% concentration. In.5% concentration only a negligible decline was observed where 100% protection was found up to 12 days and 99.9% up to 16 days in its petroleum ether and methanol extract for Phaseolus mungo. Its acetone extract gave 99.9% protectin up to 8 days 99.8% to 16 days. Cicer kabulicum showed 100% protection in petroleum ether extract up to 12 days and 99.9% up to 16 days. The methanol extract gave 100% protection up to 16 days while acetone extract gave 100% protection up to 8 days and 99.9% and 99.7% up to 12 and 16 days. Its.5% and.25% concentration also gave good results and were in the range of 100% to 99.2% concentration.

Percentage mortality of Callosobruchus chinensis was also 100% in 1% concentration of Lantana camera found in all the 3 solvents. The percentage mortality decreased in.5% and.25% concentration. Methanol extract was found to be better as compare to other solvent. As far as the percentage mortality is concerned, hot solvent extract of Parthenium hysterophorus showed better results in 1% concentration as compared to.5% and.25% concentration. All the 3 solvents gave almost 100% protection in 1% concentration. Results obtained in acetone extract were better as compared to other solvent. In.5% concentration the percentage protection slightly decline but not less than 99.1% the same was true in.25% concentration. The results obtained in the table showed that Parthenium hysterophorus hot solvent extract is quite efficient in protecting the cereals even in.25% concentration. The results of percentage mortality show 100% mortality in 1% concentration with Cicer kabulicum, Lens esculenta and Cicer areitinum. Methanol extract showed least mortality as compare to the other solvent. Percentage mortality with increased in the days of observation indicated that the lethal effective of Parthenium hysterophorus on Callosobruchus chinensis was not immediate. It appeared that it is better protectant of cereals than killing the insect and as such is a better antifeedant or diterrant compound.

Tridex procumbens hot solvent extract showed 100% protection in 1% concentration for Cicer kabulicum, Lens esculenta and Cicer areitinum in all the 3 solvents. Phaseolus radiatus was 100% protected in petroleum ether acetone extract up to 16 days while its methanol extract gave 100% protection up to 8 days. Phaseolus mungo was 100% protected in acetone extract upto 12 days and 99.9%, upto 16 days. The protection was significant in.5% and.25% concentration where protection was not less than 99.4% and 99.2% respectively in all the 3 solvent. The percentage mortality as shown in the table increased gradually with the increased in the days of observation. 100% mortality was observed in 1% concentration of the extract with the seed of Cicer kabulicum, Lens esculenta, Cicer areitinum and Phaseolus radiatus with petroleum ether and acetone extract..5% and.25% concentration gave less mortality rate which increased to 100% after 16 days..25% concentration appear to be less effective on the percentage mortality. The hot solvent extract Ageratum conyzoides appeared to be least effected as compare to the other plant extract. In 1% concentration 100% protection was found for Cicer kabulicum, Phaseolus radiatus and Lens esculenta with petroleum ether and methanol extract. Its acetone extract gave less percentage protction for Cicer areitinum and Phaseolus mungo but not less than 99% the percentage mortality was 100% in petroleum ether and methanol extract for all the days of observation in Cicer kabulicum and Lens esculenta. Similar results were observed in Phaseolus radiatus when treated with methanol extract. The percentage mortality gradually increased to 100% after 16 days with methanol extract in Phaseolus mungo, petroleum ether extract in Phaseolus radiatus, acetone extracts in Lens esculenta and methanol extract in Cicer areitinum, similar gradual increase to 100% mortality was observed upto 16 days in.5% concentration of methanol extract for Cicer kabulicum, Phaseolus radiatus and Lens esculenta. Petroleum ether also gave same results in Phaseolus radiatus and Lens esculenta. The rest of the extract gave percentage mortality between

50% to 90% same lower percentage mortality was observed after 16 days in.25% concentration of the 3 solvent extract of Ageratum conyzoides.

Protectant activity of selected plants essential oils :-

Essential oil of Azadirachta indica, Lantana camera, Tridex procumbens and Ageratum conyzoides were extracted from airal parts of the plant by Perkins apparatus. Oil from Parthenium hysterophorus could not be isolated therefore percentage protection and percentage mortality from the above 4 plants essential oils could be tested and the datas obtained have been given in the table XXXXVIII and XXXXIX. The percentage activity was observed in 1%,.5% and.25% concentration of the essential oil for 5,10, 15 and 20 days. 1% concentration of essential oils of all the plants gave 100% protection to the cereals. In.5% concentration Azadirachta indica showed 100% protection up to 20 days while that of Lantana camera and Ageratum conyzoides gave the same protection up to 15 days thereafter reduced to 99.9% after 20 days. Tridex procumbens essential oil in.5% concentration gave 100% protection up to 10 days thereafter 99.9% after 15 and 20 days. In.5% concentration the mortality percentage was low, which increased to 100% after 15 and 20 days..25% concentration of the essential oil also gave good results and the protection was found upto 99%. The percentage mortality as shown in the table XXXXIX show that 1% concentration of Lantana camera, Azadirachta indica and Ageratum conyzoides gave 100% mortality on all the days of observation. Tridex procumbens gave initially low mortality which increased to 100% after 15 and 20 days. In Azadiracht indica 100% mortality was observed during all the 4 periods of observation. Lantana camera was next to Azadirachta indica where 80% mortality was observed after 5 days and 100% observed 10, 15 and 20 days. Tridex procumbens and Ageratum conyzoides gave 60% to 80% mortality after 5 days 80% to 90% after 10 days and 100% after 15 and 20 days. In.25% concentration, the

percentage mortality further decreased. Lantana camera, Azadirachta indica, Tridx procumbens and Ageratum conyzoides gave 70%, 80%, 20% and 60% mortality respectively after 5 days this gradually increased up to 20 days. All these results indicate that essential oil of these plant were effective insecticides and retardents. They increased the percentage protection and percentage mortality with the increased in concentration. These essential oils appear to be more effective as compare to the solvent extract and they can be recommended for the development of the antifeedant or insecticidals tablets, which could be used for storage of pulses in the godowns. They will be biodegradable and at the same time ecofriendly. Similar pesticidal and insecticidal activity has been found of essential oil by numbers of workers Atri and Prasad 1979, found pesticidal activity of neem oil with future role in agriculture; Bhattacharya and Bordoloi 1986, found retartant activity of some essential oil; Ali et. al., 1983, found effectiveness of some plant essential oil against Callosobruchus chinensis; Chander and Ahmed 1986, found protectant activity of essential oil for green gram against Callosobruchus chinensis, Dale and Sarademma 1981, found antifeedant action of some essential oil; Hifnawy et. al., 1990, found larvicidal effect of the essential oil from Artemisia monosperma; Kachare et. al., 1994, found increasing storage ability of vegetable oils for pigeonpea seed against Callosobruchus chinensis; Naumann and Isman 1995, found oviposition deterrents in Azadirachta indica seed oil against moths; Pathak and Dixit 1988, found insecticidal and insect repellent activity of Tridex procumbens essential oil.

Isolation and structural elucidation of active principles :-

The isolation for carried out chromatographically on paper whatman 3 MM. The spot developed were viewed after exposed to Ammonia vapours through ultra vilot lamp and the Rf value were obtained. The spots and Rf value obtained of tested plants solvent extracts were as follows

Lantana camera blue purple in colour with Rf value.98; of Tridex procumbens and Ageratum conyzoides deep purple colour with Rf value.79; of Parthenium hysterophorus deep purple with Rf value.46 and that of Azadirachta indica fluorescent yellow with Rf value.59.

Structure elucidation was measured through UV spectra. The spots which appeared on chromatographic paper were taken out cut into the small pieces and shaken in for 10 minutes on vortex shaker with 50 ml spectral grade methanol. This was filtered and than evaporat to dryness on a rotary evaporator and the residual the obtained was redissolved in 10 ml of spectral grade methanol. This solution was measured by UV spectrum analysis. The UV spectrum obtained showed that these have flavonoids in Lantana camera extracts. The Flavonoids obtained was 5-Hydroxy flavone.

Ageratum conyzoids and Tridex procumbens solvent extracts had the same flavonoid identified as luteolin that of Parthenium hysterophorus solvent extracts was was luteolin –7-O-glucoside and that of Azadirachta indica had fisetin. The spots and the UV spectrum of the plant solvent extracts were confirmed with the spot and spectra data of authentic substances.

Protectant activity of isolated substance :-

The active principle obtained on chromatographic paper were dissolved a spectroscopic methanol after filtration and drying. These substances were used for stuiding the antifeedant activity. The substance obtained from the table L, Lantana camera gave 100% protection to cereals Cicer kabulicum, Phaseolus mungo, and Phaseolus radiatus. 90% protection was found for Lens esculenta and Cicer areitinum.

The substance obtained from the table LI to LII, Tridex procumbens and Ageratum conyzoides gave 90% protectant activity for Cicer

kabulicum, Phaseolus mungo and Phaseolous radiatus while 80% protectant activity was observed for Lens esculenta and Cicer areitinum. The substance from Parthenium hysterophorus showed the table LIII, 100% protectant activity from Cicer kabulicum and Phaseolus mungo. 90% for Phaseolus radiatus and Lens esculenta and 80% for Cicer areitinum. The chromatographic substance of Azadirachta indica showed the table LIV, highest protectant activity as it gave 100% protection for all the cereals.

Isolation of the seed Myco flora :-

Fungus flora were isolated from the seeds of mung, urd, blackgram, white gram and lentil by pour plate method. In all 18 species beloing to 8 genera, isolated. Largest no. of species isolated belong to the genus Aspergillus. These were Aspergillus niger, Aspergillus ustus, Aspergillus sydowi, Aspergillus flavaus, Aspergillus lanosum, Aspergillus Fumigatus, Aspergillus clavatus and Aspergillus quadrilineatas, 4 species of the genera Mucor where isolated out of which 3 were identified and 1 remain unidentified. These were Mucor ambiguus, Mucor varians, Mucor bacilliformis. The other 6 genera isolated were Absidia species, Penicillium species Rhizopus cohnii, Alternaria tenuis, Colletotrichum species and Pellicularia filamentosa. Some of these species have also been isolated from the seeds of these cereals by Rao 1965; Rangaswami et. al., 1970, Uppal et. al., 1935. These genera and species were identified on the basis of their cultural and morphological characteristics.

Antifungal activity of plant water extract :-

The plants selected for antifeedant activity were screened for their antifungal activity against the fungal organism isolated from the seed surface with a view to find out the effective plant extract, which could protect

the growth of the fungus of the seed surface so that loss of cereals by fungal organism could be protected during storage. Retarting effect of these extract on the radial growth of the fungus were studied and the growth rate of the fungus were measured after 24 hours up to 120 hours were noted and the data obtained has been shown in the table ..... The results show that Parthenium hysterophorus was most effective in inhibiting the growth of Aspergillus lonasum. This was followed by that of Alternaria tenuis, Colletotrichum species, Pellicularia filamentosa, Mucor varians and than Aspergillus sydowi. Rhizopus cohnii was least effected followed by Mucor species. The rest to the fungus gave intermidiate results. The extract of Tridex procumbens reduced maximum inhibition on Alternaria tenuis, Colletotrichum species and Pellicularia filamentos followed by Penecellium species Mucor varians, Mucor bacilliformis, Aspergillus flavaus, Aspergillus quadrilineatas and Aspergillus fumigatus. The organism which remain uneffeted were Aspergillus niger, Aspergillus ustus, Aspergillus, ustus Aspergillus sydowi, Absidia species, Mucor species, Mucor ambiguus and Rhizopus cohnii. These organism developed full petridish growth within 72 to 120 hours. Aspergillus clavatus and Aspergillus lanosum did not show any growth up to 120 hours and theree for appear to be inhibited to a maximum degree.

The extract of Lantana camera completely inhibied the growth of Aspergillus lanosum which could not grow at all up to 120 hours. This inhibitory effected was also observed was Aspergillus sydowii, Alternaria tenuis, Pellicularia filamentosa where growth of only 24 to 35 mm could be observed up to 120 hours. Aspergillus niger, Aspergillus ustus, Aspergillus fumigatus, Aspergillus clavatus, Mucor species, Mucor ambiguus, Mucor varians and Rhizopus cohnii remained unaffected.

Azadirachta indica water extract when used gave maximum inhibitory effect on Aspergillus lanosum where the colony could grow to the

size of 12 mm up to 120 hours. This was followed by Alternaria tenuis, Colletotrichum species, Pellicularia filamentosa, Penicillium species, Aspergillus sydowi, Aspergillus flavaus Aspergillus quadrilinealar, Mucor varians and Absidia species are uneffected while Aspergillus niger, Aspergillus ustus, Mucor species, Mucor ambiguus, Mucor bacilliformis and Rhizopus cohnii showed no sign of inhibition.

On the medium mixed with Ageratum conyzoides water extract the growth of Alternaria tenuis, Colletotrichum species, Aspergillus lanosum, Aspergillus quadrilineatas, Penicillium species, Pellicularia filamentosa, Aspergillus sydowi and mucor varians remained effected they could grow to the size of only 25 to 36 mm upto 120 hours. The rest of the organism remain very little effected as they could develop full size with in 48 to 120 hours. From the above study it could be noted that none of the water extract could inhibit all the organisms. There inhibitory effect also varied with reference to fungal organism. In general, initially the organism did not grow but later on when they became adaped to the media grew further. Alternaria tenuis, Colletotrichum species, Pellicularia filamentosa showed. Gradual increase in the growth however they were inhibited by all the plant extracts tested. These plant materials can be used in the form of mixture to protect the decomposition of seeds during storage and also for inhibiing the water bond diseases. Test for antifunal activity of plant's water extract shown in the Table LVI.

SECTION 6

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BIBLIOGRAPHY

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SECTION 7

MISCELLANEOUS

Short Communication

J. Indian bot Soc Vol 81 (2002) 175-176

ANTIFEEDANT ACTIVITY OF NATURAL PLANT PRODUCTION ON TREATED SEEDS OF PULSES AGAINST *CALLOSOBRUCHUS CHINENSIS*

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(Received June 2001; Accepted August 2001)

Antifeedant activity of different concentrations (1-3%) of crude extracts from *Ageratum conyzoides*, *Tridex procumbens*, *Azadirachta indica*, *Parthenium hysterophorus* and *Lantana camera* against the seeds of white-gram, black-gram, lentil, urd and mung were investigated. Extracts of all the plants used gave good antifeedant activity in 3% concentration. Extracts of *A.indica*, *L. camera* and *P hysterophorus* in white gram; *A. indica*, *L. camera* in black gram indicated 100% motality for *Callosobruchus chinensis*. Extracts of *A. indica* and *L. camera* failed to show significant activity in mung.

Key words : Anfifeedant activity, plant extract, pulse seeds, *Callosobruchus chinesis*.

Callosobruchus chinensis, *Callosobruchus maculatus* and *Callosobruchus analis* are the most common pests in India, belong to the family - *Bruchidae*, responsible for severe damage to the seeds of Leguminoceae. *Bruchidae* breed successfully in harvested seeds. They may pass through many succeeding generations on the seeds until the foods are exhausted (Booker, 1965; Koura *et al.*, 1971). Venkatrao *et al.*(1960) recorded 6231 fragments of insects (Bruchidae) per 100 gm of grains of Phaseolus mungo after 6 months of storage. Raju (1984) observed that losses caused by insects accounted for 6.5% of stored pulse grains. Thus the losses of pulses during storage due to these pests is a serious problem in our country. *C. chinensis* is mainly responsible for heavy damage to the storage of mung, white gram, black gram, lentil and urd at Jhansi, Generally non-bio-degradable, harmful pesticides are used to protect them during storage. Some workers have studied on natural products as protestant against pulse beetles (Ali *et al.*, 1983; Pandey *et al.*, 1986; Ahmed, and Grainge, 1986, Chauhan, and Qadri, 1989; Dixit and Saxena, 1990; Baby, 1994, Bhathal *et al.*1994 and Newrot *et al.*, 1994). The present work was a step in this direction to control these pests through some biodegradable commonly available plant materials in the most convenient manner.

Plants having medicinal value and easily available in bulk during most of the seasons were screened for antifeedant activity against *C. chinensis* after preliminary screening *Lantana camera*, *Ageratum conyzoides*, *Tridex procumbens*, *Parthenium hysterophorus* and *Azadirachta indica* were used for detailed study. Shoot protion of these plants were collected washed and air dried under shade at room temperature till constant weight. Desired quantity of 4-60 mesh size pwodered material of these plants were kept with distilled water on magnetic stirrer for 30 minutes. The filtrate obtained under suction through Whatman filter paper No. 1 was used as crude plant extract. Experiments were run in triplicates using 240 presterillized bottles of uniform volume in (5) sets, 45 for each plant extract and 3 for control. Seeds of each variety (10g) i.e. white gram, black gram, mung, urd and lentil were taken separately in all the 5 sets. 15 bottles of each set were treated with 1,2 and 3% plant extract rspectively and 3 with plain distilled water to act as control. Freshly emerged adult beetles of *C. chinensis* from laboratory maintained culture were released in each bottle. The mouth of each bottle was tide with thin piece of cloth to allow gaseous exchange and to prevent escape of beetles. Observations for the effect of 1% to 3% crude extracts were made after 10 days. Records were maitained for the weight of pulses and population variation of insects and tabulated in the Table 1. The experiments were carried out under controlled temperature and humidity.

The data mentioned in table 1 show the activity of Callosobruchus chinensis insect on 1% to 3% extract treated pulses i.e. *Phaseolus mungo* (mung), P. radiatus (urd), *Lens culinaris* (Lentil or Masur), *Cicer arietinium* (Chana black and its variety white gram). Crude extract showed varying effects on the beetles. The results obtained suggest close dependant deterrency in the extracts of all the five plants. Extract (3%) concentration of *A. conyzoides*, *A. indica*, *T. procumbens*, *L. camera* and *P. hysterophorus* caused good deterrent activity

and very little damaged was noticed in the seeds treated with 1% and 2% concentraions of plant extracts.

Table 1: Antifeedant effect of different plant extract on *Callosobruchus chinesis*.

Extracts Soaked pulses	% Morality/wt loss 9mg) after 10 days in different concentrations of A,B,C,D, and E plant extract														
	1% Concentration					2% Concentration					3% Concentration				
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
Mung	60/0.23	60.0.51	40/0.07	40/0.275	40/0.5	70/0.14	80/0.15	60/0.15	50/0.11	60/0.11	90/0.21	90/0.81	80/0.73	70/0.11	70.008
White gram	70/0.125	70/0.24	50/0.28	60/0.28	50/0.25	90/0.14	80/0.03	70.0.11	70.0.12	70/0 16	100/0.56	100/0.182	100/0 1	90/0 398	80/0.01
Urd	70/0.23	70/0.47	30/0.25	50/0.38	60/0.23	70/0.12	70/.015	70/0.22	60/0.11	70.022	90/0.376	90/0.29	90/0.2	90/0.55	80/0.075
Lntil	70/0.34	40/0.23	20/0.23	60/0.25	60/0.23	80/0.12	70/.015	70/0.22	60/0.11	70/0.22	90/0.376	90/0 29	90/0.2	90/0.055	80/0.075
Black gram	80/0.24	80/0.26	60/0.11	50/0.23	60/0.23	80/0.12	80/0.24	70/0.11	60/0.12	90/0.12	100/0.008	100/0.008	90/0.39	80/0 95	90/0 35

A-*Azadiracta indica*, B- *Lantana camera*, C-*Parthenium hysterophorus*, D-*Ageratum conyzoides*, E-*Tridex procumbens*.

The results show that seeds of white and black gram were more effectively protected from extracts of *Azadirachta indica*, *Lantana camera* and *Parthenium hysterophorous* than that of *Ageratum conyzoides* and *Tridex procumbens*, while lentil was protected more effectively from all plant extract except *Tridex procumbens*. Urd was protected more effectively from *Ageratum conyzoides* and *Tridex procumbens* extract, while *Azadirachta indica*, *Lantana camera* and *Parthenium hyterophorous* extracts were less effective. Mung seeds were protected more effectively from extract of *A. indica* and *L. camera* than that of *P. hysterophorus*, while *A. conyzoides* and *T. procumbens* extracts were least effective.

As observed from the data no correlation could be drawn from the loss in weight of the seeds and the protectent activity, it may be due to evaporation of water or assimilation of food material. As reported by Bhathal *et al.*, (1994) on *Ageratum conyzoides* and Ahmed and Grainge (1986) on *Azadirachta indica*, significant potential for pest control exist in these plants. These together with the other plants tested by the authors can be used as antifeedant products against pulse beetle *Callosobruchus chinensis*. These observations are in confirmation to those of Pandey *et al.* (1986).

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